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Contents.

	PAGE
Forthcoming Events	95
Hard White Spots in Iron Castings	95
Decline in Moulding Skill	96
The Application of Gas in the Foundry	97
The "Champion" Electric Sand Riddle	100
Blast-Furnace Gas as a Source of Power	100
Moulding a Large Pipe Casing Under Difficulties	101
International Industries Fair, Barcelona	103
British Industries Fair	103
Control of Centrifugal Casting by Calculation	104
Institution of British Foundrymen	106
Correspondence	109
Publications Received	109
Trade Talk	110
Catalogues Received	110
Iron and Steel Markets	111
Company News	112
Gazette	112
Foundry Queries	112
Deaths	112

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION

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Forthcoming Events.

Institution of British Foundrymen.

Birmingham Branch.—"On the Trail of the Brass Foundry Imp," Chap. MDCCCI., by D. Whyte, on February 11.
Scottish Branch.—"The Smelting of Pig-iron," by — Anderson, on February 11, in Glasgow.
Burnley Section.—"Oil Sand Cores, Methods and Mixtures," by J. Masters, on February 9. Annual dinner on February 11.
Falkirk Section.—"Malleable Cast Iron," by H. Williamson, on February 18.
Sheffield Branch.—"Cupola Facts, Factors and Fancies," by A. Poole. Joint meeting of the Derby and Sheffield Branches, and visits to some Sheffield works, on February 18.
Coventry Branch.—"Properties of Centrifugal Castings," by G. Williams, on February 22.

Hard White Spots in Iron Castings.

Under this same caption in our issue of December 8 we outlined some results obtained by Prof. Osann, and last week we detailed a research on the same subject by Mr. Poole, of the Keighley Laboratories. An examination of the two researches is very enlightening. Prof. Osann dealt with reverberatory-melted metal which contained roughly 0.80 silicon, 0.80 manganese, 0.26 phosphorus, and 0.10 per cent. sulphur, whereas the cupola-melted castings investigated at Keighley contained between 2.30 and 3.0 silicon, 0.25 manganese, 1.50 phosphorus, and sulphur between 0.20 and 0.25 per cent.

There is, however, one analytical point where the two totally different cases coincide—that they both contain low carbon. Referring to the analytical results, the British research says "it is important to note the low manganese content of the cast iron—in every case under examination the iron was found to be less than 0.35 per cent." As far as the metal is concerned, it is this peculiar combination of high silicon and sulphur with low iron that has a most important bearing on the formation of the internal chill.

Obviously, in the light of Prof. Osann's figures, the *only important bearing* can be their influence or association with a low carbon content. We agree with Mr. H. J. Young in his opinion that sulphur, when associated with a suitable manganese content—that is, when properly balanced—is harmless in many cases. We are in entire agreement with Mr. Poole's conclusions, which set out in another way could be reduced to two essentials—the first is to obtain a correct sulphur-manganese balance, and the second to avoid by technical means oxidising reactions in the cupola. It should be unnecessary to state that this can be accomplished by avoiding rusty or dirty scrap, a low or badly-ignited coke bed, and several other factors.

A chain in the link of Prof. Osann's theory was that the runner walls having been strongly heated are later distinctly hotter than the iron which fills it. Several practical men have doubted this, but we think that a closer observation will prove that Dr. Osann is correct. Briefly Osann's theory is that the white spots are due to a perturbation of the separation of the graphite, and are associated with low carbon, high ferrous oxide and gas content. Sulphur is not mentioned, but unbalanced it would undoubtedly be a contributory factor.

In this issue Mr. Fletcher, of the B.C.I.R.A., points out in a letter the necessity for the co-operation of the various scattered research laboratories by a central body, such as the one he directs. A study of the two researches cannot fail to convince any foundryman of its desirability. This is a case where a research laboratory can cure troubles as they arise, but on the basic underlying principle no agreement has been reached. It might be said that so long as cases are cured co-ordination is unnecessary. Such an argument is fallacious, as it does not prevent its occurrence and rapid cure in other districts. For such a question the motto of the University of Sheffield is particularly pertinent.—*Rerum cognoscere causas.*

BRITISH CAST IRON RESEARCH ASSOCIATION.—The Council of the B.C.I.R.A. would be pleased to receive for inclusion in their library any books dealing with foundry or allied matters. The name of the donor will in every case be inscribed on the flyleaf. Iron and Steel Institute Volumes are particularly asked for.

XUM

Decline in Moulding Skill.

By FRED. LONGDEN.

Last March the Engineering and the National Employers' Federations issued a useful and clear commentary and compilation of facts regarding "The Present Economic Position of the Engineering and Allied Trades." The report points out that "the fundamental cause of the existing depression is the war." There are "those who want to buy and can't," and "those who can buy and won't." Excellent reference is made to the lack of effective equilibria between foreign exchanges and monetary values, the need for new and extended capital, the necessity for more numerous, quick and longer credits, the financial stringency and the hindrance caused by industrial disputes, taxation and so on.

The one important criticism to be made on the report is that so little space is given to the serious problem of the productivity of labour. The only real reference to it is this:—"The first great misfortune is that at present, for a variety of reasons, the productivity of British labour is below its pre-war standard, and below that of workmen in competing countries."

There is considerable truth in this statement so far as it concerns iron moulding. But in this case the root weakness is the decay in craftsmanship and individual adaptability. It was equally apparent, both at home and abroad, before the war as since. In 1913 Belgium managers were deploring the fact that it was hardly possible to maintain the quantity and quality of skilled labour, let alone increase it. And even to-day, in our own country, on top of a very low market, managers persist in emphasising the condition of great shortage, not so much in conscientious men, as in really skilled and adaptable craftsmen.

The outstanding requisites of the competent craftaman are adaptability and ample knowledge of moulding, with a conscientious view as to the work he ought to do. If the numbers of such a type are increased the result will be:—(1) Higher productivity per workman; (2) relatively cheaper iron goods; (3) greater success in world markets; (4) better *pro rata* returns to capital; (5) and better wages for labour.

During the war a fairly large number of moulders possessing good skill and knowledge insisted on joining the Forces. A large portion were permanently lost to the foundry. Many were unable to re-adapt themselves to their old job after experiencing war conditions of life and service, but the far more important cause of the decay in output and skill is involved in the general attractiveness of the less responsible occupations.

This comparative attractiveness consists of three conditions, namely, hours of labour, wages, and the degree of intensity in which the work is mentally and physically exacting. In certain phases of these conditions, it is not difficult to appreciate that iron-moulding has not advanced to the same extent as many unskilled occupations. Hours are pretty much the same in general. But the point at issue is as to whether or not duration of labour should be shorter, other conditions remaining equal, in occupations such as iron moulding, which requires a comparatively higher degree of thought, attention, agility, and responsibility than most other trades.

The war undoubtedly spoilt some workers in providing "easy money." Boys will not now become apprenticed to a craft which provides a few shillings per week, during a long period of learning, necessitating constant attention and expenses for tools. At the end of this he receives as much or little more remuneration than thousands who never troubled to fasten themselves down for years in order to become efficient in some skilled occupation.

A Belgian manager, prior to the war, stated he could not understand why boys would not tackle the craft side of employment. Yet when it was suggested that the cause might be the relative attractiveness of other jobs he was inclined to agree; but, quite naturally, he objected at the cost involved in offering more conducive conditions to apprentices.

The question arises: "If boys will not come in in sufficient numbers, would not 'dilution' ease the situation?" If it stands in the way of real education and tends to produce deterioration in general skill, dilution would be a questionable blessing, either as an advance for the employee or a paying investment for the employer.

The implication here intended is that the muddling through of semi-skilled men, the gradual encroachment of the unpractised, lowers the general standard of craftsmanship. Undoubtedly, cabinet-making, pattern-making, building, fitting and the like are in a similar position. But there is just the difference that in moulding the uses of machinery and dilution are very limited. A craftsman moulder cannot be made of an adult who has been otherwise employed all his life. It requires the plastic clay of youth, the right make-up, and an adequate apprenticeship.

Dilution might be introduced in certain phases. If, for instance, newcomers were put in place of those accustomed to lower-grade and specialised jobs, an appreciable though temporary decrease in output would result. But then the men so displaced would be more fitted to tackle still higher-grade moulding. In the same way these second-grade men might be adapted to better-class work. By this means the ranks of the higher grades of skilled men might be swelled, whilst room would be made at the bottom for new recruits to start at the beginning on the simple processes of first-grade work. So the demand for men might be eased. That is all.

The difficulty is that men and even boys who have spent most of their lives on jobs of a more or less routine or specialised order are seldom of use for changes of any considerable importance. They never become moulders in the best sense of the word, and the experienced foundry manager knows it.

Remedies.

The above-mentioned Report of the Employers' Federation misses a most important issue when it states that: "It was hoped that the reduction of hours by their improvement in the physical conditions of manual labour would have led to such a higher output per hour as to compensate for the loss of productive hours."

Even assuming the existence of purely manual labour in the moulding department, the facts remain that knowledge and skill have become rarer in the meantime through war and other conditions. Skill and knowledge always will count as against ordinary manual labour during times of change.

The conclusion is that British employers must take the longer view of the serious need of a far better supply of competent craftsmen.

For its accomplishment the following examples may be cited:—

In 1914 the then British Westinghouse Company, of Manchester, provided good scope for workshop practice by apprentices, who were made to think and use their intelligence in tackling a relatively greater variety of jobs. Additionally to better wages being offered as an inducement, classes were instituted in working hours at the employers' expense. Such is excellent foresight and an investment that pays. The firm retained a good proportion of its own produced talent.

In the same year, in the special moulding department at the Mechanical School of Liège, Belgium, classes were instituted by means of which the craft was exhaustively taught. The school produced splendid future craftsmen, foremen, and managers, and instituted a movement worthy of extension throughout the country.

As employers expected proficient men from this school, they contributed towards the cost of its maintenance, and financial support came from local educational authorities.

A similar project is about to be attempted, providing grants are forthcoming by the Smethwick Borough Education Committee, whose Technical School is modern and efficient.

Local authorities should launch out on lines similar to those of Liège and Smethwick. Employers should offer the best conditions relative to hours, wages, workshop training, and time to attend day technical classes. Trade Unions should guarantee an adequate supply of youthful recruits to the trade.

The future prosperity of the country depends on such foresight, on the general training of the youth; for the greatest want of the times is a quick rehabilitation of industry.

XUM

The Application of Gas in the Foundry.

Much has been said from time to time of the many uses to which gas has been applied, and this article is for the purpose of illustrating how the Mond gas generated at the works of the National Gas Engine Company, Limited, is fully utilised.

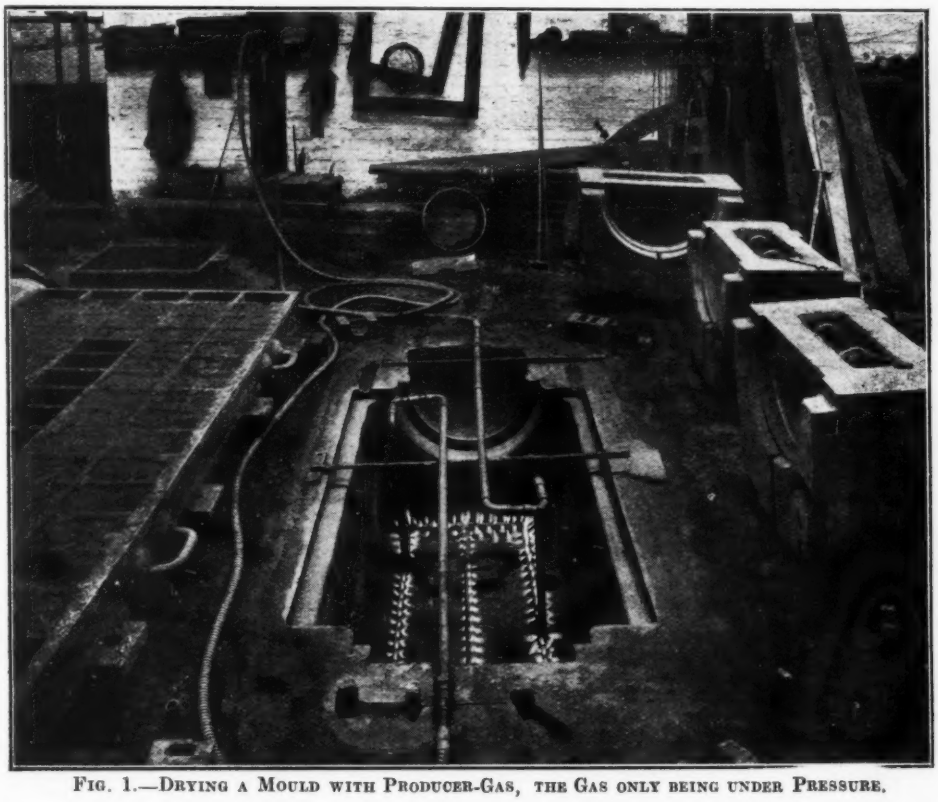


FIG. 1.—DRYING A MOULD WITH PRODUCER-GAS, THE GAS ONLY BEING UNDER PRESSURE.

It will, of course, be understood that the gas is mainly required for the driving of the numerous gas engine units which are installed at various convenient centres throughout the works, and used for power and lighting purposes. Also a large quantity of gas is used on the test-plates for the testing of engines of varying sizes up to 1,500 B.H.P. It is, however, not proposed to deal with the question of gas for power purposes so much as with the question of the various other uses to which the gas has been applied.

FIG. 2.—CORE STOVE SHOWING CARRIAGE IN POSITION; THE NATIONAL GAS ENGINE COMPANY.

The generation of the gas is carried out by means of a Mond producer plant, designed and manufactured by the Power Gas Corporation, Limited. The plant consists of three generators, which are each capable of gasifying 10 cwt. of coal per hour, and producing 60,000 to 70,000 cub. ft. of gas of from 125 to 130 B.Th.U.'s value. Adjacent to the plant is situated sulphate of ammonia recovery and tar dehydrating apparatus. From the by-products of this installation a large revenue is derived, which considerably reduces the cost of the gas.

Mond gas is used with great advantage in the foundry in connection with the drying of moulds and cores, and is supplied to a service pipe running throughout the foundry at a pressure of 12 in. (water gauge). Fig. 1 illustrates a vertical engine crankcase mould made in the foundry floor, and the method employed for the drying. The gas is conveyed from the main by means of a flexible pipe, and is passed over the top of the mould by

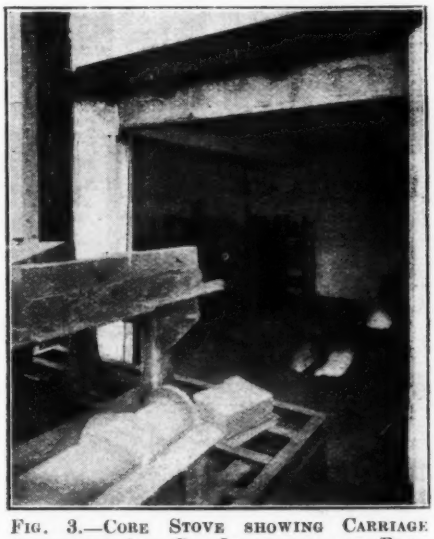


FIG. 3.—CORE STOVE SHOWING CARRIAGE WITHDRAWN AND GAS LIGHTED IN THE PITS. GAS ONLY IS UNDER PRESSURE.

means of a wrought-iron pipe. The reason for doing this is that the gas is to some extent pre-heated before the final combustion takes place. A mould of this size can be thoroughly dried by means of gas in approximately 3½ hrs. During the process of drying the mould is covered over with the cope supplemented by corrugated iron sheets. The great advantage of mould-drying by gas, as compared with the coke-fire method, will be apparent to all foundrymen, as no extensive cleaning of the mould is required before placing the cores in position.

The drying of cores by means of gas is shown in Fig. 2, the gas being conveyed in pipes under the ground to the core oven. The combustion of the gas takes place below the floor level, in order that the carriage carrying heavy cores can be run over these fires, as shown in Fig. 3.

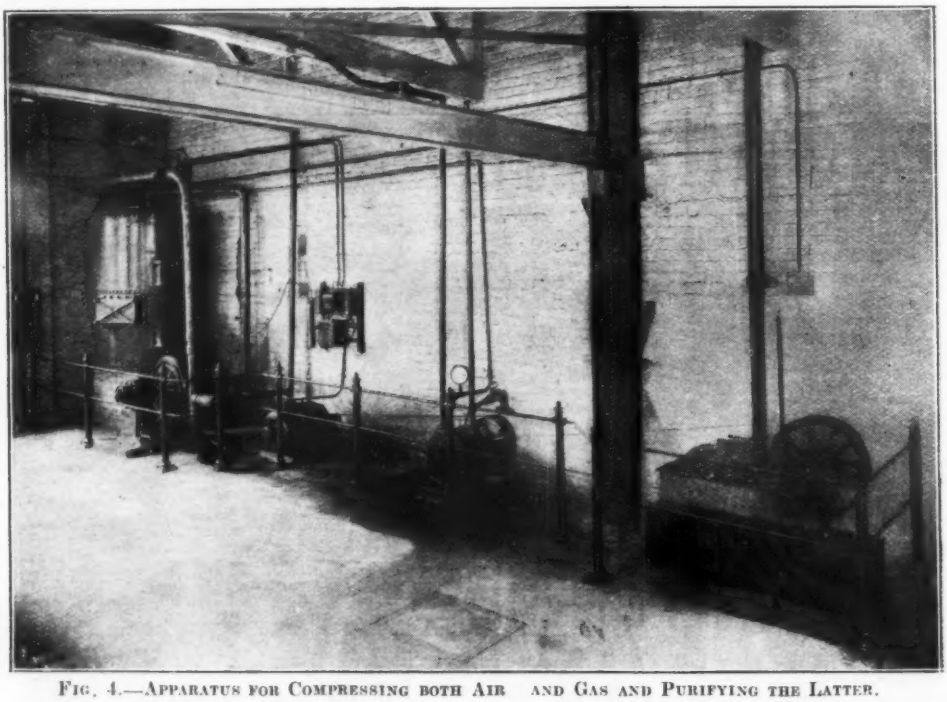


Fig. 4.—Apparatus for Compressing both Air and Gas and Purifying the Latter.

The Advantages of Gas-fired Core Ovens.

Primarily, there is the small amount of attention required, as once the gas is ignited no further attention is required until the oven has been raised to the temperature required, when the gas can be turned down sufficiently to bake the cores.

Fig. 5.—Tinning Bath for White-metalling Bearings Heated with Producer-Gas, both Gas and Air being Under Pressure.

Secondly in importance is cleanliness, as no dirt, dust, or ashes can accumulate during the use of the stove, and the cores are much cleaner when removed.

Other advantages are quickness of operation for the time required to dry the cores is much less than in the case of the coke-fired stoves, being approximately four hours for even very large cores.

Lastly, the fumes from the gas are not objectionable, owing to the extra purifier used, and do not fill a foundry with thick smoke.

An additional advantage worthy of mention in connection with the use of gas in a modern foundry is that the gas producer can, during the morning, supply gas for drying cores and moulds and driving

FIG. 6.—CASE-HARDENING FURNACES HEATED WITH PRODUCER GAS; NATIONAL GAS ENGINE COMPANY'S WORKS AT ASHTON-UNDER-LYNE.

a generator for lighting and crane purposes, and during the afternoon the gas can be utilised for driving the cupola blower.

Babbitting and Case Hardening.

Mond gas is utilised in connection with the heating of baths and furnaces in the babbitting and case-hardening departments. For this purpose the gas is conveyed to a purifier and drawn through same by means of a motor-driven booster. This increases the pressure of the gas to approximately 12-in. (water gauge). A view of this auxiliary plant is given in Fig. 4. The small machine shown in the centre of the picture is a compressor, delivering air at a pressure of 4 to 5 lbs. per sq. in., and this air is mixed with the gas for use in the babbitting department.

The metal-melting baths in the babbitting department are shown in Fig. 5. It will be seen that there are four baths, varying in size to suit the requirements of the work in hand.

At the front of each bath is fitted a three-way mixer, which is supplied with respectively Mond gas, air, and towns gas. It should, however, be particularly noted that the towns gas is only required in the case of any special week-end work, when the Mond producer plant is not in operation. The gas and air are mixed to ensure perfect combustion, and the mixture is then carried under the bath to suitable burners arranged according to the design of the bath. The metals which are melted are principally tin, best white metal, lead and antimony. These metals are used in connection with the lining of engine bearings, varying in size from 2 to 16-in. bore. At the extreme corner of the babbitting shop is shown a metal-moulding machine of the Monometer type, and this is heated by Mond gas in a similar manner.

The case-hardening, heat-treating and annealing shop, which is shown in Fig. 6, contains four furnaces, each of which is supplied with Mond gas under pressure and induced air. The burners are of the Bunsen type, with air regulator. The furnaces vary in size, and are capable of dealing with parts up to 6 ft. in length. The temperature to which these furnaces can be heated is in the neighbourhood of 1,200 deg. C. This temperature can be attained in about three hours. The temperatures of the furnaces are obtained by means of a Cambridge double thread recording pyrometer. This is connected to each furnace, and registers their individual temperatures. The particular advantage of this instrument is that an accurate record is indicated on a chart of the heat of each furnace throughout the day. There is also coupled to each furnace a wall-type pyrometer, and, again, in addition to this, the temperatures of the furnaces

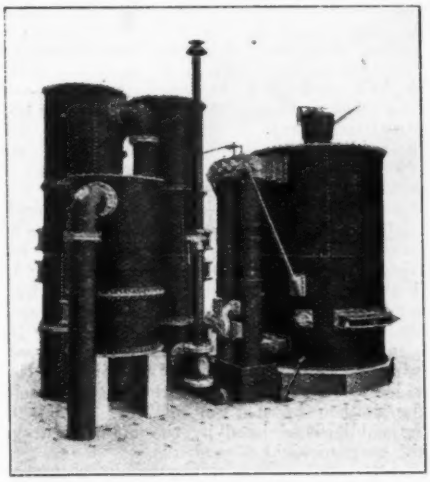


FIG. 7.—THE NATIONAL "GOLD MEDAL" SUCTION-GAS PLANT.

can be obtained by means of a radiation pyrometer, as shown in front of furnace No. 2.

For cases where the amount of gas required for power purposes, heating, core drying, etc., is not so excessive. The National Gas Engine Company manufacture what are known as "Gold Medal"

put of 30,000 cub. ft. per hour. These plants for producer-gas plants in standard sizes up to an output power and heating purposes are the outcome of many years' experience with this class of work. The National Company have supplied numerous installations of this kind for all classes of work, including laundries, enamelling, brazing, and various other processes requiring gas heating.

Briefly, the complete plant consists of a gas generator, scrubber, gas purifier, exhauster and pressure regulator. After the plant is started up the only labour necessary is for the purpose of refilling the hopper with fuel, which is only required to be performed about once every two or three hours, and occupies only a few minutes. The plant can quickly be started up from a cold condition, is easy of access for cleaning purposes, and is generally so designed that any unskilled labourer can easily understand and attend to it. A National gas-producer plant, capable of supplying 12,000 cub. ft. of gas per hr. is shown in Fig. 8.

The "Champion" Electric Sand Riddle.

Of all fatiguing jobs in the iron foundry few are more exacting than riddling sand, and any machine which can economically and mechanically accomplish this work will be generally welcomed.

The machine we illustrate below has recently been placed upon the British market by Messrs. C. H. W. Mitchell & Company, of 142, West Regent Street, Glasgow. This particular model is designed to take any standard 18-in. riddle.

The machine is driven by a ¼-h.p. electric motor, running at 1,800 r.p.m. By means of a flexible coupling it actuates, through worm gearing, a steel crank which, with a 2½-in. swing, drives the riddle arm. This arm is of steel, and at its pivot it is provided with a simple bearing consisting of a 1-in.

THE "CHAMPION" ELECTRIC SAND RIDDLE

steel ball and two V-shaped runways. This arrangement communicates to the riddle an elliptical movement.

The riddle holder is a spring steel frame, which grasps the riddle and eliminates screws and clamps.

The slot shown on the rear leg of the machine is to allow of the transporting of the machine after the manner of a wheelbarrow, the riddle frame forming the handles, but when the machine is at work the leg is lifted and the wheel is allowed to slide up the slot so that the leg rests firmly on the ground.

Adequate means are taken to ensure the smooth running of motor and gears, an oil bath being provided for the latter, whilst the whole is enclosed in the manner shown.

The riddle is claimed by the manufacturers to do the work of eight men.

SIR FRANCIS HENRY BARKER, who died recently at Cannes, at the age of 57, was chairman of the executive council of the Russo-British Chamber of Commerce. Sir Francis was a director of Vickers, Limited, Vickers-British East Africa, Limited, Vickers-Petters, Limited, Canadian Vickers, Limited, and vice-chairman of Metropolitan-Vickers Electrical Company, Limited.

Blast-Furnace Gas as a Source of Power.

Our attention has been drawn to some extraordinary results which have been obtained in Belgium from the direct utilisation of blast-furnace gas. Owing to the recent industrial crisis, very few of the Belgian blast furnaces were in blast, and some of the works which rely upon gas engines for their power found themselves in the peculiar position of being entirely dependent upon one blast furnace for their gas supply. Up to the present no one has ventured, for obvious reasons, to install gas engines in a works which only possesses one blast furnace. However, recent experience has clearly shown how ill-founded were the fears of a stoppage of the power supply due to accidents to the furnace and consequent lack of gas.

In the John Cockerill Works at Seraing, Belgium, which employ at the present time upwards of 9,000 hands, the whole of the electric power required since May last, *i.e.*, seven months, has been produced by gas engines driven by the gas supplied from one single blast furnace. The running of the power station was entirely dependent on this furnace, none of the old steam blowing engines or boilers being in use. When it was found necessary to stop the blast furnace for any reason, such as repairs to the tapping hole, etc., the time was chosen (for instance, a Sunday) when the power station could be temporarily closed down.

To start the furnace again the operations were as follows:—The blast furnace was blown by means of a cupola fan, and in this way gave sufficient gas to purge the gas mains up to the gas-cleaning plant. The latter was then started up and delivered the gas to the gas-driven blowing engine at a pressure sufficient to allow the engine to run. The power station could then be immediately started up again as required.

From the foregoing it will be seen that the confidence which the Cockerill Company have always placed in their type of gas engines appears to be amply justified, and tends to substantiate the claim that their reliability is at least equal to that of steam turbines. As the result of their experience, they further claim that the utilisation of blast-furnace gas for the production of motive power should only be obtained through the intermediary of gas engines, as the power produced in this way is equal to more than twice that which would be available through using steam turbines.

The Cockerill Company were certainly the first to construct and use large modern gas engines, and in their shops was built the largest and most powerful gas engine ever designed. It behoved them, therefore, to take full advantage of the unique opportunity afforded by only having one blast furnace in blast to obtain reliable figures on the distribution and utilisation of the gas produced. An exact statement of this kind is usually impossible, or very difficult, to obtain in normal times, because the gas produced by several furnaces is, as a rule, led into a common main, and the lay-out of the mains rarely allows the output of the gas to be measured there, where it would be most interesting to obtain it.

The No. 7 blast furnace at the Cockerill Works, which was the only one in blast, is some considerable distance away from the central electric power station and the blowing engine house. The gas mains are straight and of sufficient length to ensure the absence of surges and cross currents. These conditions were therefore exceptionally favourable for measuring the amount of gas passing. Tests made in October last show that 35 per cent. of the gas was absorbed by the hot-blast stoves, 10 per cent. by the gas blowing engines, 5 per cent. was lost, and 50 per cent. was available for the gas-driven central electric power station. For a consumption of 200 tons of coke per 24 hours, the load shown at the switchboard of the central station was 4,000 kw., corresponding to an average load on the gas engines of 77 per cent. of their full power (1 b.h.p. absorbing as a maximum not more than 2,700 calories per hour with the load factor).

It is finally to be noted that the whole of these results were obtained under normal working conditions, no special efforts being made to obtain the maximum efficiency from the engines.

Moulding a Large Pipe Casing Under Difficulties.

By "Egur."

Where it was Made.

The casting to be described, while made under difficulties which will be appreciated by most foundrymen, may also, perhaps, show how, under seemingly hopeless conditions, success can be attained, provided proper forethought is exercised. Our foundry was a very antiquated place, and comprised two small shops. One was the jobbing shop, a square building about 30 ft. × 30 ft., the height being ample. The crane was a jib built entirely of wood, with the exception of the gearing. It was very old, and groaned and complained under stress. However, like many other old horses, comparatively speaking, it could take a heavy load. Pivoted in the centre of the shop, it swung round the full circle. The other shop was at right angles to the jobbing shop, and measured about 70 ft. × 18 ft. Here there was a fairly modern hand travelling crane, which was worked by chains depending from the gearing overhead. It was woefully slow, and the supports on which it rested were wooden beams held up by wooden posts laid

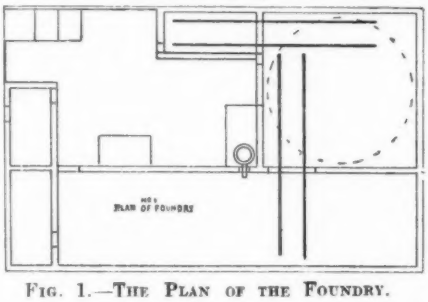


FIG. 1.—THE PLAN OF THE FOUNDRY.

against the wall. This crane was supposed to be of 5-ton capacity. It had two powers, but the higher was almost useless, as it worked so extremely slow. The other was therefore used mostly, and often at great risk to the safety of the men, as it had a nasty habit of getting the upper hand and running away when lifing heavy loads. From one corner of the jobbing shop, and as an extension into the yard, the drying stove was built. It was of the ordinary primitive type, having a firegrate in one corner; the smoke and heat being directed across the stove diagonally to a downtake flue leading to the chimney. To transfer a job from the travelling crane to the jib was not possible without first of all lowering on to a bogie. This allowed it to be pushed through to within the radius of the jib crane. The gauge of this bogie suited the rails leading in to the drying stove.

When a mould had to be dried in the stove the bogie and mould together were lifted, and while suspended turned a quarter circle before lowering on to the stove rails. Obviously much time was wasted here.

The cupola, which was 27 in. inside dia., was placed in the corner of the yard formed by the two shops. The spout projected through the wall supporting one side of the travelling crane, it being easier and more serviceable to handle molten iron with this crane. Fig. 1 roughly represents a plan of the foundry.

Making the Tackle.

No moulding plant existed which came near the size and requirements for making our job; therefore we had to plan out a complete rig from the beginning. A blue print drawing, a sweep and a template were supplied by our customer. This drawing showed a half moulding box for making cast-iron pipes of about 24 in. dia., the sweep, the exact shape outside, and the template the shape of the side flanges. A reference to Fig. 2 will show its form and size. Our contract was to supply six complete boxes or 12 castings. The first idea was to make a moulding box similar in shape to the casting, only bigger, but as this meant leaving on our hands, after the contract was completed, a box unsuitable for ordinary work, we discarded the idea in favour of the one to be described. The length required amounted to about 16 ft. over all, so to simplify the making of the box and also to plan it that it would be handy for other work afterwards we made it in halves. The sides of the box were not made the full depth for the same reason. Reference to Fig. 3 will show how it was made up, and the depth secured by shaping the bars. The bars were made loose to simplify the making of the box, and also that they could be easily removed to suit other work at a future time. How these were shaped and fastened can be seen from Fig 3. It may here be remarked that the nearest approach to an engineer or fitter on the premises was the usual hammer and chisel variety—a foundry dresser. The ends of the box on the upper edge had to follow closely the shape of the mould so as to simplify the making of the parting; and the sweep just cleared them when swung in position. Across the ends at the top edges were fastened two bars, each having a straight top edge, and a half-round bearing in the centre, to suit the spindle on which the sweep was mounted. These bars are shown in Fig. 4. While fixing them in position, care was taken to have them out of winding, so that a straight edge worked across the two bars swept a true joint, and therefore true edges to the casting. This, of course, was an important point on the finished job, and it also secured means for taking accurate measurements. The half-box being completed, it was necessary then to make a covering plate and grid for forming the top half of the mould. First of all a plate was cast, 3 in. thick, and the full outside sizes of the moulding box. Projecting lugs and legs were cast on to facilitate lifting and turning over. Holes also were cored in position for allowing the fixing of the grid to this plate and for the forming of the gates of the casting. This plate is shown in Fig. 5. On the underside were cast the usual spikes for holding the loam.

The grid was formed from two end-plates fitting the ends of the moulding box, and a number of bars shaped to follow the outline of the finished mould with about 1 in. clearance. These bars had holes

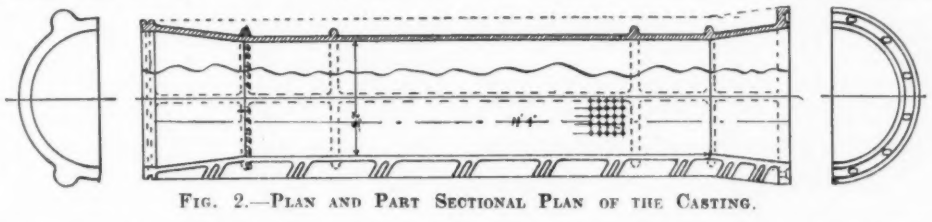


FIG. 2.—PLAN AND PART SECTIONAL PLAN OF THE CASTING.

cast in as shown in Fig. 6. The two D-shaped holes were used for allowing two cast-beams to pass. On to these beams the bars already referred to and the end plates were fitted and bolted in their proper places. On the top side of each beam, at a suitable distance apart, two malleable-iron staples were fixed. These were high enough to project through the covering plate when the complete grid was in position upon it, and by means of wedges passing through these staples the whole grid was fixed firmly to the covering plate. Besides being easily made up this arrangement allowed us to disconnect the grid from the heavy covering plate if necessary, as shown in Figs. 3, 4 and 6.

Building up the Job.

Our moulding plant then was complete enough to make a start on the mould. First thing we did

was to sink the moulding box into the floor, leaving the upper edge about 16 in. above the surface, and keeping the face level all round. Next, the mould was constructed of the usual loam, bricks and mortar until within rough size of 1½ in. to the finished mould. By leaving fireboxes conforming to the shape and suspended inside overnight, each course of brick was carefully dried before another was applied. A steam tube, 3½ in. dia., and long enough to project beyond the ends of the moulding box, was used as a spindle for the sweep. Then three straps were cast, each having a socket for

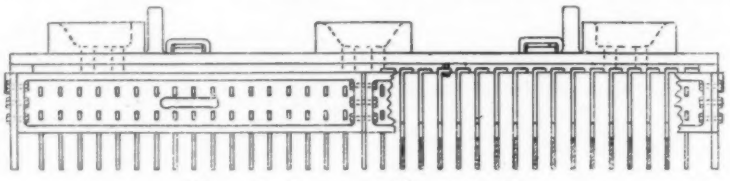
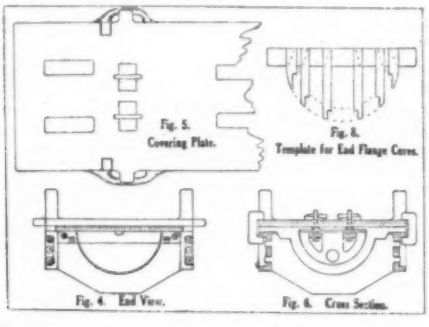


FIG. 3.—COMPLETE MOULDING BOX.

the spindle near the centre, and at one end bolt-holes to fix the wooden sweep. The other end was used for taking a balance weight. These weights were a great assistance for keeping control over the sweep when shaping the mould. The ordinary crank-shaped handles were wedged into each end of the spindle, and collars were fixed to prevent end play (see Fig. 7). With the blue print drawing to guide us, the wooden sweep was fixed to its proper distance from the spindle on the arms already described, and we were ready to form the mould proper. This was done in the usual way by using finer loam as the mould became nearer to the size. For the centre rib, running the full length of the casting, we made a loose wood pattern and



bedded it in position during this operation. The snugs shown on one end were also bedded in at this period. The joint of the mould was then swept true and fair by means of a straight edge resting on the straight bars already described. As there were machining strips cast on the side flanges the joint was kept ⅜ in. below the centre. This distance was made up by the pattern for the machining strips being bedded in to the top part of the mould afterwards.

The bottom half of the mould being now faced up it was allowed to dry, and the wood strip forming the mid-rib was removed. After drying, the sweep was adjusted to the inside size of the cast-

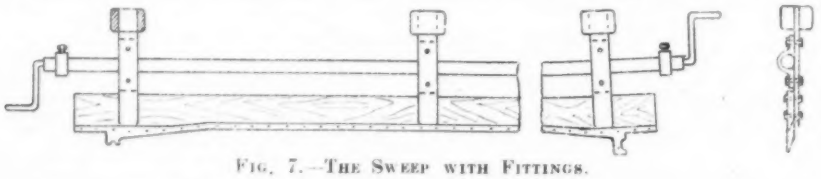


FIG. 7.—THE SWEEP WITH FITTINGS.

ing, and its shape altered to suit. Then fine moulding sand was laid all over the mould and swept out until a smooth surface was obtained. We had then a sand pattern, and the surface was coated with parting sand preparatory to making up the top part. The grid already described, detached from the covering plate, was placed in position, and strips ¾ in. × ¾ in.—representing the combined thickness of the fitting strips with machining allowance—placed along the joint of the mould, exactly as shown on the blue print. These were secured in place with nails. Loam was now laid all over the sand pattern, access being obtained between the bars forming the grid which was just like working with an ordinary top part while detached from the plate. After this cooling was completed, the loam-work was finished by bricks and mortar in the usual way. When the grid was all made up, a layer of loam was laid over the top and across the joint. It was thick enough to ensure the covering plate bedding thoroughly all over. Thickness pieces of iron were set at various positions along the top edge of the moulding box to prevent the covering plate crushing the grid into the drag. After allowing time to air-dry, the whole top-part the wedges were passed through the staples and the grid fixed firmly to the top plate. The whole was then parted off and finished ready to put in the stove.

Transport Difficulties.

If we had had the top part to part off and rest on supports only, without turning over, we would have been most grateful; but it had to be turned over to finish and to lay on the bogie. This was a most nerve-trying operation, nobody having confidence in the crane keeping a grip of the load. However, by passing one end well through the doorway while up on edge, we at least took certain precautions to prevent a bad accident. With a sigh of relief the job was accomplished, and although much time was taken up transferring the bogie to the jib crane, and relifting to put it on the stove rails, we managed it all without any damage being done. It took several days to dry the top part as we were anxious to do it thoroughly. Our plans embodied that we should not require to do this part of the job again, as we expected by parting off the top after casting, and while the casting was still hot we should keep the top part in such good condition that only local patching would be necessary. To do this successfully, it is necessary for the top part to be thoroughly dry initially. Returning to the mould, the sand pattern was cleared out and the mould finished so far.

Flanges and Cores.

The side flanges were next scraped out, using a batten as guide. This batten was shaped to suit and firmly fixed along the joint of the mould and ends, no movement being possible. The flanges having been thus formed and finished, cores were placed around the end flange as shown in Fig. 2. Their position was accurately fixed by means of the template (Fig. 8). The other end had two snugs only, these having been formed by means of loose wooden patterns. The snugs were now drawn, and all was ready for the small vent-hole cores. Before fixing them, however, the mould was thoroughly dried by means of the fire baskets. Once the drying was completed, the small cores were distributed all over the surface of the casting at about 2 in. centres. They were about ⅜ in. dia., the length being exactly the thickness of the metal casting. To fix these small cores a wire was passed through their centres when being made, leaving a hole slightly easy for the passing of a wire nail. The mould surface was then marked off by means of a piece of chalk, a straight edge and a piece of flexible steel, with lines crossing at

right angles at 2 in. centres. After that, it was easy to place the cores where the lines crossed, and by passing the wire nails through them and into the mould they were securely fixed. The top part having been previously properly dried and finished, it was closed on and secured with clamps. The heads were made up, and all was ready for casting.

Pouring Details.

The ladles were one of 3 tons capacity and a 1-ton. As the casting was about 3 tons weight we could not afford to be short of their full capacity. The cupola was the best part of the plant, it having been constructed on modern lines, and could always be depended upon. This being so we could melt very hot metal, and had no difficulty in getting sufficient to cast the job before it had cooled too much. In casting we nearly filled the mould from the 3-ton ladle, before setting the 1-ton going to fill up. As we intended, we parted off the top, before the casting had gone black-cold. Although unavoidably the end flanges tore up a bit, the damage to the mould was never so serious but that it could be easily repaired and dried by hot-plates applied locally. We continued this process of patching and casting without a hitch, and could cast one of these castings every second day with certainty. Only one moulder was on the job. He was assisted by two labourers when sweeping out the drag, but at other times had only one labourer. No doubt we could not have done with so few men had it not been for the thorough planning of the rig-out and the strength and security of the whole moulding box. We were also grateful for having a foreman who had no prejudiced notions, and carried out the ideas of the management to the letter. When we consider that the top covering plate weighed about 4 tons, and with the grid filled with loam attached, it must have been close on 6, it must be admitted that the job was too big for our plant. However, as we said at the beginning, with efficient preparation and planning it is surprising what may be done when backed up by determination.

International Industries Fair, Barcelona.

The third International Industries Fair of Spain, which will be held at Barcelona from March 15 to 25, will be open to international trade, and it will therefore offer a unique opportunity to British manufacturers to secure a substantial share of the foreign trade of Spain.

The exhibiting rates are 600 pesetas (about £22) for a stand of approximately 14 square metres, whilst installations in the open air run about 18s. the square metre.

In conjunction with the Fair a special party of business men (organised by the Spanish Travel Bureau, of 11, Queen Victoria Street, London, E.C.4) will leave London on March 13, and for the inclusive sum of 55 guineas will remain abroad for a period of 14 days, visiting places of commercial and industrial interest not only in Barcelona, but Madrid, Toledo and San Sebastian. The fare will provide first-class travelling throughout and superior hotel accommodation. Cheaper tours are also being arranged.

Electric Smelting of Iron Ore.—According to Mr. Frank Hodson, president of the Electric Furnace Construction Company of Philadelphia, U.S.A., electric smelting furnaces may be broadly divided into two groups—those using open-top furnaces, in which no attempt is made to use the escaping gases, and the Swedish "Electrometall" type of furnace, in which the smelting is done in a closed chamber. The gases and products of combustion pass through a central shaft, through which the charge is fed down to the final reduction zone. These gases materially assist in the quick reduction of the ore, which is very economical, compared to an open-top furnace. This type of furnace has been in successful commercial use in Sweden and Norway for the past ten years, and large plants with the "Electrometall" smelter are now being constructed in Italy, Japan, and Brazil. Some of the furnaces at present constructed have a capacity of 5,500 kw., but improved design of furnace will make it possible to have furnaces of this type of double the present capacity.

British Industries Fair.

Trade is hampered in many ways, and the revival seems a long time coming. Last year it was especially hampered by a three months' coal strike, the economic effects of which were felt throughout the world. It was also hampered by extravagant national and local expenditure, by the resulting excessive burden of taxation, by the violent fluctuations of the foreign exchanges, and last, but not least, by the condition of Russia and the financial depression in many of our overseas markets. When we come to examine the effect of all these things we find it to be an all-round shortage of ready money, serious restriction of credit, and the consequent absence of facilities for long credits.

In every market firms of all sorts have been forced to let business slip through their fingers because it has been impossible to replenish stocks without paying cash on delivery, or at short date. Manufacturers in their turn have been unable to sell goods which were urgently wanted, because they had not got the money to give the credit essential to impoverished buyers.

With the passing into law of the Trade Facilities Act, British manufacturers and merchants may now be enabled to give credit from twelve months up to six years, according to the commodity, to any of their foreign customers. This means that foreign buyers of all sorts of commodities can now buy British goods without putting down a single penny at the time of purchase.

In a word the Act is an arrangement by which the British Government is prepared to grant credit on behalf of any responsible British manufacturer and merchant who needs it. A scheme of such far-reaching importance deserves to be brought repeatedly before the commercial community, because it contains within its provisions facilities which, if properly used, cannot fail to be of great benefit. Actually it is an extension of the Overseas Trade (Credits and Insurance) Act of September, 1919, but its scope is so much more generous and comprehensive that there is no doubt of the good results it will have for every kind of trade; one of its best points is that the buyer is not troubled over the transaction in any way for the ultimate repayment of the credit, which may extend over one year or six, according to his requirements. Where the credit is not required for more than a year the British Government will back the bill for the total value of the invoice, and where longer terms are required the Government backing will be to the extent of 85 per cent. of the bill.

In short, foreign and overseas buyers of all nations who want credit merely approach the British manufacturer or exporter of their choice, and he arranges everything with the Export Credits Department of the Department of Overseas Trade.

The value of this scheme to foreign and overseas buyers is too obvious to need any emphasis. It applies to every country in the world, except Russia and India, and can be used for any transaction, however small. There is already at least one case in existence where, under the old Act, a credit was applied for and given for a sale amounting only to £40.

The fact that any British manufacturer or exporter can obtain these credits has already made itself felt in connection with the forthcoming British Industries Fair. As the facilities which the new Act offers become better known the more widely will the importance of the Fair to the buyers of all countries be recognised.

The coming Fair is the eighth and most important of the series, and will be held simultaneously in London and Birmingham from February 27 to March 10 next. Practically all trades are included, and already the number of representative firms who have taken space makes it clear that 1922 will prove another great step in its progress.

THE late Mr. Joseph Taunton, J.P., Widney Manor, Knowle, Warwick, and of Messrs. J. & J. Taunton, bedstead manufacturers, Sherbourne Road, Birmingham, and a director of the Palmer Tyre Company, left £94,598.

Control of Centrifugal Casting by Calculation.*

By Robert F. Wood.

Centrifugal casting, as here dealt with, concerns concentric methods or those wherein the axis of rotation lies within the casting, in a central position. As the casting operation may be carried out in a horizontal, a vertical, or an inclined position, methods of casting fall naturally into three corresponding divisions.

The simplest, oldest and commonest method of making centrifugal castings, and the one which produces by far the greatest tonnage, is with the axis of rotation lying in a horizontal plane. The fluid material, such as molten metal, is introduced into a horizontally mounted rotating mould, over the interior surface of which the material becomes

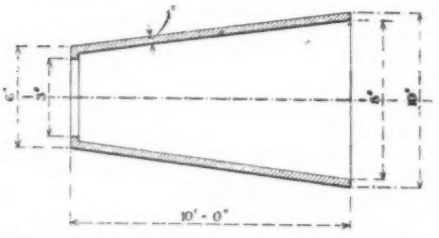


FIG. 1.—DIMENSIONS OF DESIRED CASTING.

spread out by the action of centrifugal force. When solidification has taken place there is obtained a casting whose outer conformation is a reproduction of the internal shape of the mould, and whose inner surface is cylindrical and symmetrical about the axis of rotation.

Vertical casting also has been practised for a long time, but in its application has not found nearly so broad a field as has the horizontal method. Here, again, the method consists essentially of introducing molten metal or other fluid material into a rotating, but in this case vertically mounted, mould. Instead of forming a cylindrical inner surface, as in horizontal work, the metal here takes a bowl-shaped form; the shape of this curve is that of a paraboloid of revolution, and the higher the speed of rotation, the more nearly

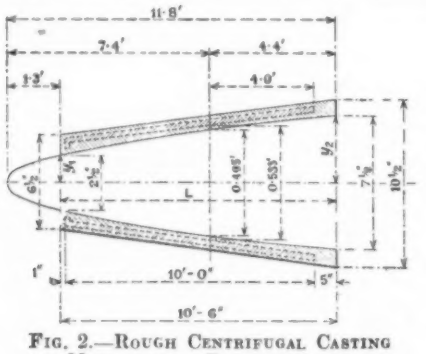


FIG. 2.—ROUGH CENTRIFUGAL CASTING FOR MACHINING TO DIMENSIONS, SHOWN IN FIG. 1.

parallel will the sides of the paraboloid become. If the speed is kept relatively low the resulting casting will be only moderately hollowed out, or dish-shaped, and with intermediate speeds intermediate results will be obtained.

If the axis of rotation be inclined, a casting with a more or less bowl-shaped interior will result, and here, too, by properly adjusting the speed, the bore of the casting may be made to approximate either the near-cylindrical or the bowl or dish shape. Mathematically considered, the inclined axis opens to us the general case, a concentric centrifugal casting made in any position; the horizontal and vertical positions are special cases at the two limiting extremes of the general proposition.

* Abstract of Paper read before the American Society of Mechanical Engineers.

Castings with Paraboloidal Bores.

The production of castings with paraboloidal bores by use of inclined or vertical methods is covered in a number of patents extending over the past fifty years.

The inclined or the vertical method is indicated wherever the requirements of the shape of the bore can be approximated by a paraboloid, as, for instance, in the production of a casting whose finished bore is to be the frustum of a cone. The specific purpose for which this control was devised and used was the production of hollow tapering brass castings about 6 in. in diameter and upward of 20 ft. long for submarine-periscope tubes. However, as the solution is here worked out for the general case, it may be used to determine conditions for making concentric centrifugal castings of any size and in any position.

Owing to the simplicity in principle of horizontal casting, it finds but little application there; inclined casting, however, is not so self-evident in principle, and really requires this exact means of control which is especially useful in connection with large work where cut-and-try methods are ruinous and where dependable data must be at hand before adequate specifications can be drawn for equipment, or intelligent plans made for its use.

It can be shown that the bore of a casting made with axis inclined is paraboloidal, and that the equation of the parabola has the form $x=ay^2$, with the axis X coinciding with the axis of the casting and with the vertex at the origin. The coefficient a has the value $a=0.61463\ (R^2/\sin\alpha)$, where R is the revolutions per second and α is the angle of inclination of the axis. Another value for the coefficient a is found to be $a=L/(y_2^2-y_1^2)$, where y_2 and y_1 are any two radii (in feet) of the bore, and L the axial distance (in feet) between them.

Production of a Given Casting.

Suppose, now, it is desired to produce a rough casting which will allow of machining to the shape and dimensions shown in cross section in Fig. 1. Allowing finish on the various diameters and extra length for cropping, the rough casting to be obtained, with its dimensions, may be taken as shown in cross section in Fig. 2, which also illustrates where the parabola will be located with respect to the casting.

Taking the radius of the large end of the rough casting as y_2 and the radius of the small end as y_1, the equation of the parabola which will generate the required force is found to be $x=121\ y^2$.

At this point it is well to determine the speed range within which the parabola $x=121\ y^2$ may be produced. From the equivalent expressions for the coefficient a it is seen that for every assigned value of inclination α there will be a corresponding value for R, the speed of rotation. In the example before us the highest speed that may be used is found by assigning the values $a=121$ and $\alpha=90$ deg., which makes $R=14$ revolutions per second, or 840 revolutions per minute for the mould vertically placed.

For a very elongated parabola, owing to the high value of the coefficient a, the speed corresponding to vertical or steeply inclined positions may come out so high as to show at once that only moderate values of α should be selected if it is desired to avoid excessive speeds of rotation.

The lower limit of speed may be found, theoretically, at the least inclination whose corresponding speed value is just sufficient to carry the metal around in the mould. This theoretical lower limit need not be solved for, however, as requirements of practice naturally demand a higher value, determined experimentally or in regular operation. If we assume that the lowest practical speed for a casting of this type has been set at 400 revolutions per minute, we may then use the values $a=121$ and $R=400/60=6.67$, getting thereby the value $\alpha=13$ deg. inclination. For every value between 13 and 90 deg. there may be found in similar fashion a corresponding speed value lying between 400 and 840 revolutions per

minute, and every correlated pair will produce identically the same shape of casting. (This suggests the somewhat odd conception of the possibility of a rotating mould waving irregularly about during the casting operation without detriment to the shape of the casting, provided only that the rotation be accelerated or retarded in harmony with the gyrations of the apparatus.) It may happen, in case the coefficient a has a low value, that the lowest speed permitted by requirements of practice can be attained or approached only by use of the highest speed allowed by the equation of the bore, i.e., by using the vertical position; a good example of this may be found in the Huth patent.

From the foregoing will be seen the utility of these calculations in the design of equipment. By ascertaining the equation of the parabola that will give to the bore the desired shape, and then by assigning the desired speed or range of speeds of rotation there may be obtained immediately the angle or the range of inclination of axis, which must be known before plans for the casting equipment can be laid out. Conversely, having given the range of speed and the range of inclination of any machine, it is then possible to ascertain whether any particular piece of work will fall within those limits.

Weight of Metal Required.

Having found the relations between inclination and speed, it is convenient to find the weight of metal needed to form the casting. This is done by taking the difference between the volume of the mould (frustum of a cone) and the volume of the bore (frustum of a paraboloid) and applying to it the per-unit weight for the metal used. For the case in hand the volume is thus found to be, by well-known formulæ, 2.42 cub. ft., which, if the metal weigh 500 lbs. per cub. ft., indicates 1,210 lbs. as the weight needed to make the given casting. Shrinkage may be allowed for in the per-unit weight used. In this connection it is worth while noting that no matter what be the per-unit weight of the material, the control equations are not changed; conditions relating speed, inclination, and shape of bore are the same whether for lead or for aluminium.

As in other matters, many specific cases will be found to have features peculiar to themselves for which special provision must be made. For instance, after ascertaining the equation of the parabola that would fit in with the rough inside diameters assigned in Fig. 2, it would be desirable to find out whether the bore as cast would encroach at any point upon the thickness of extra metal needed for inside finish, owing to the bulging shape of the sides of the parabola. In some cases these factors can be taken care of without calculation, in others it may be necessary to determine the diameters of the rough bore at certain points, or to solve by familiar methods for the slope of the curve [for parabola or form $x = ay^2$ the slope is $1/2\sqrt{(ax)}$ or $1/2\ ay$], to compare this scope with the shape of the finished bore at and near the point under examination and then to modify the parabola accordingly if necessary. To illustrate, the slope of the wall of the finished casting (Fig. 1) is $\frac{1}{2}\ (10-6)/120$ or 0.0167, corresponding to 0 deg. 57 min., while the slope of the parabola at the large end of the casting, where y has been found to be 0.3125 is $1/(2\times121\times0.31325)$ or 0.0132, corresponding to 0 deg. 46 min., which, being less, indicates that there will be at least some encroachment of the kind mentioned. By investigating the amount and the location of this encroachment by a side calculation, it will be found that there remains a finish of 7-16 in. on the inside diameter at the most critical point. If this finish is not enough, the lack is made up by taking a smaller inside diameter for either end or for both ends of the rough casting and recomputing the parabola.

Application of Calculations to Long Tubes.

Another use to which these calculations could be put is to control the casting of long cylindrical tubes of small diameter, in which there might be some likelihood of the metal not reaching evenly to the far end of the mould before freezing. In cases like this it is evident that the cylindrical shape could be approximated by setting the mould at a slight inclination and driving it at first, during introduction of the metal, at a speed relatively low, thus giving the metal a chance to flow downward, then increasing the speed so as to obtain the near-cylindrical shape. This plan is closely equivalent to the mode of operation in a number of old patents, among them 648,601 (U.S.A.), Stridsberg, 1900. By calculating the shape of the bore for the several speeds used this kind of control could be developed quite satisfactorily. Speed requirements for the vertical casting of near-cylindrical shapes may be calculated in a similar way. No illustrations are needed here, because the computations are similar to those already described, differing only in their application.

Regulation of Speed or of Centrifugal Force.

Reference was made to the fact that calculation of the theoretical lower limit of speed was made unnecessary by reason that requirements of practice demand a higher value. By this is suggested a question upon which there has been a little difference of opinion among various operators of centrifugal casting processes, and since it directly concerns the subject of control, a brief analysis of it here should not be out of place. Let us say that in order not to rotate the mould so slowly as to run the risk of spoiling the casting, a certain speed of rotation has been settled upon and accepted as the most favourable one for castings of a certain diameter. It seems pretty well agreed that having been determined for one diameter, this favourable speed condition should be extended, if possible, for the sake of uniformity in practice, to cover other diameters. In the main, two different means have been adopted in the effort to bring about such uniformity, and these are, first, to so regulate the speed in revolutions per minute as to hold the peripheral speed at a constant figure, or, second, to so regulate it as to hold the centrifugal force at a constant figure, for all diameters. A third plan is to so regulate the speed as to keep at a constant figure the tensile stress, regarding the casting as the rim of a flywheel, which it resembles in certain aspects as soon as solidification has gone far enough to allow shrinkage to begin to draw the casting in, away from the sides of the mould. If the first plan is examined, it will be seen that the revolutions per minute must vary inversely as the diameters; in the second plan, on account of the nature of centrifugal force, the revolution per minute will have to vary inversely as the square roots of the diameters; the third plan figures out like the first. The second set of conditions is therefore irreconcilable with either of the other two, which indicates that any effort to find conditions under which the metal of similar castings of different diameters would be subjected to identical physical forces is likely to be a prolonged one.

Conclusion.

In closing, it may be observed that possibly some foundrymen will look askance at what may seem so far from sand and patterns; they may rest assured, however, that what has been set down here is of an entirely practical nature in the field within which it applies, and that once understood in principle the calculations described do not offer the difficulty nor require the time that might be anticipated on first reading.

Hammer-Welded Steel Pipe.—Hammer-welded pipe is made by the National Tube Company in the United States by bending a steel plate into tubular form with edges overlapping. The plate is bent on long horizontal rolls, in much the same manner as are plates for boiler shells, but they are bent completely around until the edges overlap. The tube is then taken to the welding machine, where a short section of the overlapped edges is heated to a welding temperature by water-gas burners, placed opposite—inside and outside the pipe. The heated portion of the seam is hammer-forged on an anvil supported by a long counter-balanced beam, after which the contiguous portion is heated and welded. These alternate heating and hammer-forging are continued until the entire length of pipe is welded. After being welded, the pipe is placed in an annealing furnace and heated to remove strains and refine the grain. Hammer-weld pipe is made with a range of thicknesses from ¼ to 1½ in. Considering the tensile strength of the material, this range of wall thicknesses gives the engineer a wide working basis for computations on those problems where large safety factors must be provided. Sizes from 24 to 96 in. are listed by the makers.

Institution of British Foundrymen.

SHEFFIELD BRANCH.

THE FLUIDITY OF MOLTEN METALS.*

(*Continued from p. 74.*)

Naturally, the chemical composition of an alloy played a great part in the result. The chemical composition might affect the fluidity of an alloy in several ways. In the first place, the presence of an impurity might alter the true fluidity, but that influence was not usually very great. The metals did not vary much in fluidity. The co-efficient of viscosity ranged from that of water, which was only just over 0.01, and that of the metals was not above 0.03, at most, so that mixing together different metals did not make a very great difference in the true fluidity. But it did make a very great difference in the apparent fluidity in this way.

Berlin Castings.

Suppose that an iron casting was required to fill a very intricate pattern.

Some years ago (he did not think it was the case now) certain firms in Berlin used to make some fancy iron-castings—which were very much sought after—such articles as fruit stands for table centres and so on. They were almost as delicate as silver filigree work, but were made by using only cast iron. They were known as Berlin castings. In order to get the very great degree of fluidity that was required for those elaborate castings, very high-phosphorus iron was used. From 2 to 5 per cent. of phosphorus was present in some of those castings. Brittleness, of course, did not matter, as they were not meant to stand any shock; all that was required was a perfectly clean casting in a very intricate mould.

Indirect Action of Elements.

Phosphorus might possibly increase the true fluidity, though this was by no means quite certain, it was possible—but it did very much lower the melting point of the iron, so that iron, being poured at given temperature, had a much greater range of temperature before it became completely solid when working with a high-phosphorus iron than when using a low-phosphorus material. The fluidity was increased in that way. Then, taking again the example of cast-iron, it was common knowledge that silicon had a great influence on the fluidity of the iron, a high silicon iron producing more fluid iron. There, again, the effect was probably an indirect one. Supposing that a white iron with very low silicon was taken, with all the carbon in a combined state, one knew that it would be very difficult to get an intricate casting in that metal. In order to get the casting, the metal would have to be made exceptionally hot. In casting from a crucible, the requisite amount of superheat could be obtained, but in casting from a cupola one could not get the same degree of superheat, for reasons explained below. Differences would therefore be found between different grey irons. Taking three materials, a Swedish white iron, with all the carbon in a combined state; secondly, a grey iron, having relatively large graphite plates, and the carbon in the free state, with some areas that were free from graphite; and a third, where the graphite was in small particles distributed much more closely throughout the metal, so that there was no portion of the metal which was at a considerable distance from the graphite. Mr. Riddel read a Paper some time ago on the fluidity of cast iron, and he suggested that the great difference between cast irons in the cupola was that, if a cast iron, having large graphite plates, was examined, the greater part of the carbon would be in free condition—it was as graphite—the matrix in which the graphite was embedded would be practically a low carbon steel. In the cupola, the temperature that was reached was not much above the melting point of the metal, in the case of white iron. In a white iron casting the iron and the iron-carbide were very closely intermixed; they had a definite melting point. As soon as that melting point was reached, the metal melted, ran down through the coke bed, and collected in whatever receiver might be used there. The metal was obtained practically at its melting point; there was no chance of much superheat. As soon as the metal was liquid it ran down, and as the hottest part of the cupola was the point just where it was being melted it ran down practically at the melting point; it collected in the receiver with very little superheat, and this metal had to be used for casting at a temperature only just above its melting point. With a grey iron, this was not the case. The larger the graphite plates were the longer it took for the carbon to be absorbed by the matrix of the metal.

Why High Silicon Irons Carry Superheat.

Where they had very small graphite plates, there the absorption was more rapid. Other things being equal, high-silicon tended to favour these larger graphite plates, and a relatively low, combined-carbon matrix. Therefore the high silicon irons did not melt until a considerable degree of superheat had been obtained. The low-silicon irons melted almost at their theoretical melting point. That seemed to account very largely for the influence of silicon. It was probably not a direct influence on the fluidity, but rather an indirect influence, by determining the ease with which the carbon was taken up by the low-carbon matrix of the iron. The matrix of a grey cast-iron, containing phosphide, was practically a 0.9 per cent. carbon steel. The phosphide tended to bring down the melting point very much, and to make the mass flow more readily, but liquid cast-iron was not obtained until the graphite had been absorbed. The graphite was shown by large black masses, at considerable distances from some points in the metal, and a large superheat was required before these were completely dissolved, so that the fully carburised liquid iron was not obtained until a quite considerable degree of superheat had been obtained; hence more fluid metal resulted.

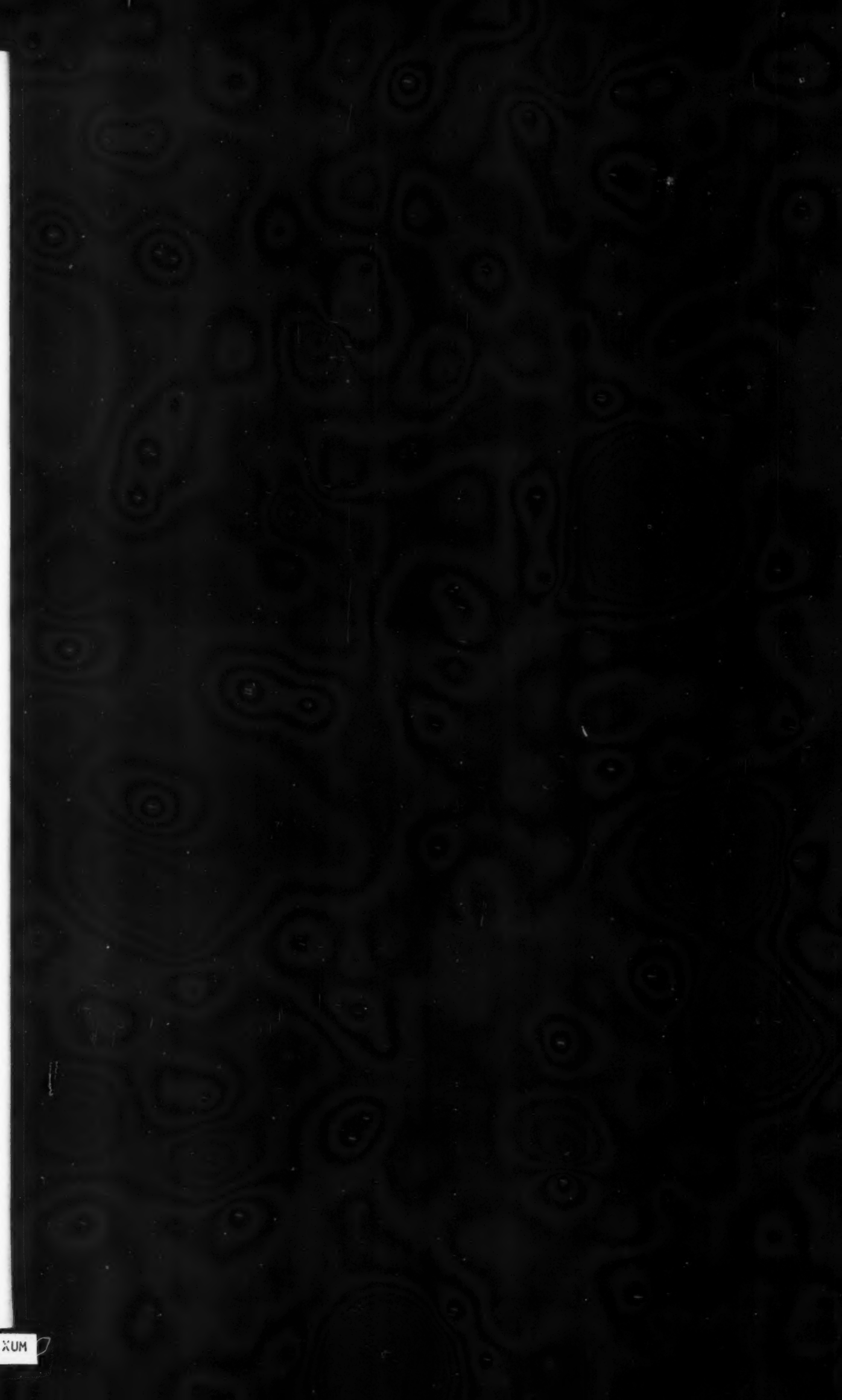
Evidently, then, the chemical composition was most important in its indirect effect—not in its effect on the actual fluidity, as measured by means of a viscosimeter, but in its indirect effect in altering the degree of superheat; and this was more marked in cupola practice than in crucible melting. Obviously, with a crucible or with an air furnace, any degree of superheat required could be obtained, but in the cupola they were limited by the temperature at which the metal melted and came down, and if the constituents were in such a form that they reacted readily with one another, as in a white iron, then it was impossible to get any great degree of superheat in a cupola without alteration of conditions. On the other hand, if the constituents were such that they reacted only sluggishly, then they did not get complete melting until there was a considerable degree of superheat, and consequently a hotter metal which ran more readily in the mould was obtained. That seemed to be the main influence of chemical composition.

Effect of Oxygen on Fluidity.

It would be very interesting to know whether there was a direct influence as well. In the case of steel it was known, of course, that the presence of oxygen affected the fluidity very greatly. In the presence of oxygen, one had a relatively sluggish metal, which did not run so freely. The dissolved oxide undoubtedly had a bad effect. The influence of other elements was comparatively little known, and there was one point on which the author would welcome discussion, and that was:—What was the influence of very high silicon? In Sheffield it was the practice to make steel containing a high proportion of silicon—4 per cent. or thereabouts—for electrical purposes, and he had never been able to get a quite definite opinion on the point whether that metal was more or less fluid than a steel of the same carbon content with only the ordinary proportion of silicon. As to the influence of other alloying metals, very little information seemed to exist. There must be differences in fluidity, but they were so complicated by other factors that it was not easy to say what was the actual influence of added metals on the fluidity of such an alloy as steel. Apparently that was a point on which much more definite information was required, and probably it would be wise, when a programme of foundry research was being planned, to include actual quantitative experiments on the influence of various metals on the fluidity of steel

* A Paper by Dr. C. H. Desch.

XUM



December 31st, 1921.

BLAST FURNACES OF THE UNITED KINGDOM

BUILT AND IN BLAST.

Compiled from Returns Received Direct from the Furnaces, and Published at the Offices of

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(Formerly JNO. STEVENSON),
MIDDLESBROUGH and Newcastle-on-Tyne.
PIG IRON. COALS. COKE.
HOME AND EXPORT.

Total number of Furnaces Built on December 31st, 1921	485
Total number of Furnaces in Blast on December 31st, 1921	81
Decrease in the number of Furnaces Built	2
Increase in the number of Furnaces in Blast since Sept. 30th, 1921	13

Furnaces Blown-in since Sept. 30th, 1921 ... 30

Scotland (3).—Summerlee Iron Co.. 3.
North Wales (1).—Darwen & Mostyn Iron Co., 1.
South Wales (6).—Briton Ferry Works, 1; Baldwins, Ltd., 1; Guest, Keen & Nettlefolds, 1; Blaenavon Co., 1; Ebbw Vale Steel, Iron & Coal Co., 2.
Durham & Northumberland (2).—Carlton Iron Co., 1; Linthorpe-Dinsdale Smelting Co.,1.
Lincolnshire (3).—Redbourne Hill Iron & Coal Co., 1; John Lysaght, Ltd., 2.
Cleveland (6).—Gjers, Mills & Co., 2; Tees Furnace Co., 1 Linthorpe-Dinsdale Smelting Co., 2; Wm. Whitwell & Co., 1.
West Cumberland (1).—United Steel Companies, 1.
South and West Yorkshire (1).—Parkgate Iron & Steel Co., 1.
Derbyshire (2).—Sheepbridge Coal & Iron Co., 1; Staveley Coal & Iron Co., 1.
Northamptonshire (4).—Islip Iron Co., 2; Lloyd's Ironstone Co., 2.
South Staffs., etc. (1).—M. & W. Grazebrook, 1.

Furnaces Blown-out since Sept. 30th, 1921 17

Scotland (6).—James Dunlop & Co., 3; David Colville & Sons, 3.
Durham and Northumberland (1).—Consett Iron Co., 1.
West Cumberland (2).—Millom & Askam Hematite Iron Co., 1; Whitehaven Hematite Iron & Steel Co., 1.
South and West Yorkshire. (2).—Newton, Chambers & Co., 2.
Lancashire (3).—Barrow Hematite Steel Co., 2; North Lonsdale Iron and Steel Co., 1.
Derbyshire (3).—Butterley Co., 1; Denby Iron & Coal Co., 1; E. P. Davis, 1.

Furnaces being built at present time 16

(See below).

Furnaces being Re-lined at present time 66

Durham (7).—Consett Iron Co., Ltd., 5; Linthorpe-Dinsdale Smelting Co., 1; Pease & Partners, 1.
Nottingham and Leicestershire (1).—Stanton Ironworks Co., 1.
Cleveland (19).—Cargo Fleet Iron Co., 1; Bolckow, Vaughan & Co., Ltd., 9; Sir B. Samuelson & Co., Ltd., 2; Dorman, Long & Co., Redcar, 1; Skinningrove Iron Co., Ltd., 1; Cochrane & Co., 3; Pease & Partners, 1; Tees Furnace Co., 1.
South Staffordshire (4).—M. & W. Grazebrook, 1; Wm Roberts (Tipton), 1; N. Hingley & Sons, 1; Bradley & Foster, 1.
Staffordshire, North (3).—Robert Heath & Low Moor, 2; Goldendale Iron Co., 1;
South and West Yorkshire (2).—Newton, Chambers & Co., 1; Yorkshire Iron & Coal Co., 1;
Cumberland (2).—United Steel Companies (Workington), 2.
Derbyshire (3).—Sheepbridge Coal and Iron Co., Ltd., 1; Staveley Coal and Iron Co., 1; Denby Iron and Coal Co., Ltd., 1.
Northamptonshire (2).—Kettering Iron and Coal Co., 1; Wellington Iron Co., 1.
Lincolnshire (5).—North Lincolnshire Iron Co., Ltd., 3; Frodingham Iron and Steel Co., 2.
Lancashire (3).—North Lonsdale Iron and Steel Co., Ltd., 2; Carnforth Hematite Iron Co., 1.
Scotland (8).—James Dunlop & Co., 1; Wm. Dixon, Ltd. 1; Shotts Iron Co., 1; Wm. Baird & Co., 3; Langloan Iron and Chemical Co., 1; Carron Co., 1.
South Wales (7).— Ebbw Vale Steel, Iron and Coal Co., Ltd., 2; Guest, Keen & Nettlefolds, Ltd., 3; Blaenavon Co., 1; Briton Ferry Works, 1.

Scotland.

Name of Firm.	Total in blast on Dec. 31.	In blast Dec. 31. making Hem.	Fgs. & F'dy.	Basic.	Average in blast. Dec. qr	Sept. qr	Total built.	Furs relining
Langloan Iron and Chemical Co., Ltd., Coatbridge	—	—	—	—	—	—	5	1
Coltness Iron Co., Ltd., Coltness	—	—	—	—	—	—	9	—
Dixon, Wm., Ltd., Calder	—	—	—	—	—	—	7	—
Dixon, Wm., Ltd., Govan	—	—	—	—	—	—	6	1
Dunlop, Jas., & Co., Ltd., Tolcross	—	—	—	—	2	—	5	1
Glasgow Iron and Steel Co., Ltd., Wishaw	—	—	—	—	—	—	6	—
Merry and Cuninghame, Ltd., Carabroe	—	—	—	—	—	—	5	—
Shotts Iron Co., Ltd. ..	3	—	3	—	2½	1½	5	1
Summerlee Iron Co., Ltd. Coatbridge	3	—	3	—	3	—	7	—
Baird, Wm., & Co., Ltd., Gartsherrie	4	—	4	—	4	4	12	—
Baird, Wm., & Co., Ltd., Muirkirk	—	—	—	—	—	—	3	—
Baird, Wm., & Co., Ltd., Eglinton	—	—	—	—	—	—	6	3
Baird, Wm., & Co., Ltd., Lugar	—	—	—	—	—	—	5	
Dalmellington Iron Co., Ltd., Dalmellington	—	—	—	—	—	—	5	—
Merry & Cuninghame, Ltd., Ardeer	1	—	1	—	1	1	5	—
David Colville & Sons,	—	—	—	—	2½	3	7	—

Cleveland District.

Name of Firm.	Total in blast on Dec. 31.	In blast Dec. 31. making Hem.	Fgs. & F'dy.	Basic.	Average in blast. Dec. qr	Sept. qr	Total built.	Furs relining
North Eastern Steel Co., Ltd.	2	—	2	—	2	2	4	—
Gjers, Mills & Co., Ltd.	2	2	—	—	2	—	5	—
Cargo Fleet Iron Co., Ltd.	—	—	—	—	—	—	3	1
Tees Furnace Co., Ltd., Lackenby	1	—	1	—	1	—	3	1
Bolckow, Vaughan & Co., Ltd.—								
Clay Lane	—	—	—	—	—	—	4	—
Cleveland, South Bank	—	—	—	—	—	—	5	1
Cleveland Steel Works, Eston	—	—	—	—	—	—	2	—
Middlesbrough ..	—	—	—	—	—	—	2	1
South Bank	2	1	1	—	2	—	3	—
Grangetown	2	2	—	—	¾	—	6	—
Linthorpe - Dinsdale Smelting Co., Ltd. (Linthorpe Iron Works)	—	—	—	—	—	—	3	—
Sir B. Samuelson & Co., Ltd.	1	1	—	—	1	¼	8	2
Pease & Partners, Ltd., Normanby Iron Works	2	2	—	—	2	1½	3	1
Cochrane & Co., Ltd. ..	—	—	—	—	—	—	3	3
Dorman, Long & Co., Ltd. Redcar Ironworks	—	—	—	—	—	—	6	1
Skinningrove Iron Co., Ltd.	—	—	—	—	—	—	5	1
Pease & Partners, Ltd.,	—	—	—	—	—	—	3	—

Northamptonshire.

Name of Firm.	Total in blast on Dec. 31.	In blast Dec. 31. making Hem.	Fgs. & F'dy.	Basic.	Average in blast. Dec. quarter	Sept. qr	Total built.	Furs relining
New Cransley Iron Co...	—	—	—	—	—	—	2	—
Executors of P. Phipps, Hunsbury Hill Iron Works	—	—	—	—	—	—	2	—
United Steel Companies. Ltd, Wellingboro'	—	—	—	—	—	—	4	—
Islip Iron Co., Ltd., Thrapston	2	—	2	—	2	—	4	—
Kettering Iron and Coal Co., Ltd., Kettering	—	—	—	—	—	—	3	1
Wellingboro' Iron Co., Ltd., Wellingboro'	—	—	—	—	—	—	3	1
Lloyd's Ironstone Co., Ltd.	2	—	2	—	1½	—	3	—
Totals	4	—	4	—	3½	—	21	2

South Staffordshire and Worcestershire

T. & I. Bradley, Ltd. (Capponfield)	—	—	—	—	—	—	2	—
Bradley & Foster, Ltd., Darlaston	—	—	—	—	—	—	2	1
G. & R. Thomas, Hatherton	—	—	—	—	—	—	2	—
Earl of Dudley, Brierley	—	—	—	—	—	—	4	—

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Baird, Wm., & Co., Ltd., Eglinton	—	—	—	—	—	6	3	
Baird, Wm., & Co., Ltd., Lugar	—	—	—	—	—	5	—	
Dalmellington Iron Co., Ltd., Dalmellington	—	—	—	—	—	5	—	
Merry & Cuninghame, Ltd., Ardeer	1	—	1	—	1	1	5	—
David Colville & Sons, Ltd., Glengarnock	—	—	—	—	2½	¾	7	—
Carron Co., Carron	1	—	1	—	1	1	4	1
Totals	12	—	12	—	16	8	102	8

North Wales.

Brymbo Steel Co., Ltd.	—	—	—	—	—	—	1	—
Darwen & Mostyn Iron Co., Ltd., Mostyn	*1	—	—	—	1	—	3	—
Totals	1	—	—	—	1	—	4	—

*One furnace making ferro-manganese, etc.

South Wales.

Briton Ferry Works, Ltd. Briton Ferry	1	1	—	—	1	—	2	1
Baldwins, Ltd., Cwmavon Works, Glamorgan	—	—	—	—	—	—	2	—
Baldwins, Ltd., Swansea Hematite Works, Landore	1	—	—	1	1	—	2	—
Crawshay Bros. (Cyfarthfa), Ltd.	—	—	—	—	—	—	5	—
Guest, Keen & Nettlefolds, Ltd., Dowlais	1	1	—	—	¼	—	4	—
Guest, Keen & Nettlefolds, Ltd., Cardiff	—	—	—	—	—	—	4	2
Guest, Keen & Nettlefolds, Ltd. (Cwmbran, Mon.)	—	—	—	—	—	—	1	1
Blaenavon Co., Ltd., Blaenavon	1	1	—	—	¾	—	3	1
Ebbw Vale Steel, Iron and Coal Co., Ltd.	2	2	—	—	1½	—	8	2
Pyle & Blaina Works, Ltd.	—	—	—	—	—	—	2	—
Totals .. .	6	5	—	1	4½	—	33	7

Durham and Northumberland.

Carlton Iron Co., Ltd., Ferryhill	*1	—	—	—	1	—	3	—
Bell Bros., Ltd., Clarence Works	2	—	—	2	2	—	11	—
Consett Iron Co., Ltd., Blackhill	3	3	—	—	3	2½	8	5
Palmers Shipbuilding and Iron Co., Ltd., Jarrow	—	—	—	—	¾	—	5	—
Linthorpe-Dinsdale Smelting Co., Ltd., Middleton	†1	—	—	—	¾	—	4	1
Seaton Carew Iron Co., Ltd., West Hartlepool	—	—	—	—	—	—	4	—
Pease & Partners, Ltd., Tees-Bridge Iron Wks.	2	—	2	—	2	2	3	1
Weardale Steel, Coal and Coke Co., Ltd., Tudhoe Furnaces, Spennymoor	—	—	—	—	—	—	2	—
Totals	9	3	2	2	9½	4½	40	7

*One furnace making ferro-manganese, etc.
† ditto.

Lincolnshire.

Appleby Iron Co., Ltd., Frodingham	—	—	—	—	—	—	4	—
Frodingham Iron and Steel Co., Ltd., Doncaster	1	—	—	1	1	1	4	2
Redbourn Hill Iron and Coal Co., Ltd.	1	—	—	1	1	—	4	—
North Lincolnshire Iron Co., Ltd., Scunthorpe	—	—	—	—	—	—	3	3
Trent Iron Co., Ltd., Scunthorpe	1	—	—	1	1	¾	3	—
John Lysaght, Ltd., Normanby Park Steelworks, Scunthorpe	2	—	1	1	1	—	5	—
Totals	5	—	1	4	4	1¾	23	5

Notts. and Leicestershire.

Bestwood Coal and Iron Co., Ltd., near Nottingham	—	—	—	—	—	—	4	—
Stanton Ironworks Co., Ltd., Ashfordby	2	—	2	—	2	2	4	1
Totals	2	—	2	—	2	2	8	1

Shropshire.

Madeley Wood Co. ..	—	—	—	—	—	—	3	—
Lilleshall Co., Ltd. ..	—	—	—	—	—	—	3	—
Totals	—	—	—	—	—	—	6	—
Pease & Partners, Ltd., Normanby Iron Works	2	2	—	—	2	1¼	3	1
Cochrane & Co., Ltd. .	—	—	—	—	—	—	3	3
Dorman, Long & Co., Ltd. Redcar Ironworks	—	—	—	—	—	—	6	1
Skinningrove Iron Co., Ltd.	—	—	—	—	—	—	5	1
Pease & Partners, Ltd., Tees Ironworks	—	—	—	—	—	—	3	—
W. Whitwell & Co., Ltd.	1	1	—	—	—	½	3	—
Totals	13	9	4	—	11	5½	74	19

NOTE:—Basic heading includes furnaces making Cleveland pig-iron for steel-making purposes.

West Cumberland.

United Steel Companies, Ltd., Harrington, Derwent Solway, Moss Bay, Workington.	3	3	—	—	3	¾	18	2
United Steel Companies, Distington	—	—	—	—	—	—	3	—
Millom & Askam Hematite Iron Co., Ltd., Millom	—	—	—	—	¾	¾	6	—
Whitehaven Hematite Iron & Steel Co., Ltd.	—	—	—	—	—	1	3	—
Totals	3	3	—	—	3¾	2	30	2

North Staffordshire.

Midland Coal, Coke and Iron Co., Ltd., Apedale	1	—	1	—	1	1	5	—
R. Heath & Low Moor, Ltd., Stoke	1	—	1	—	1	1	6	2
Goldendale Iron Co. ..	—	—	—	—	—	—	2	1
Stafford Coal and Iron Co., Ltd.	—	—	—	—	—	—	4	—
Shelton Iron, Steel and Coal Co., Ltd., Stoke	2	—	2	2	2	1½	3	—
Totals	4	—	2	2	4	3½	20	3

South and West Yorkshire.

Walter Scott, Ltd., Leeds Steelworks	1	—	1	—	1	1	4	—
R. Heath & Low Moor, Ltd.	—	—	—	—	—	—	2	—
Parkgate Iron and Steel Co., Ltd.	1	—	—	1	1	—	3	—
Newton, Chambers & Co., Ltd., Sheffield	—	—	—	—	2	2	3	1
York Iron and Coal Co., Ltd., Leeds	1	—	1	—	1	1	5	1
Wm. Woodhead & Son, Ltd., Bradford	—	—	—	—	—	—	1	—
Totals	3	—	2	1	5	4	18	2

Lancashire.

Millom & Askam Co., Ltd., Askam	—	—	—	—	—	—	1	—
Charcoal Iron Co., Ulverston (Backbarrow)	1	1	—	—	1	1	1	—
Barrow Hematite Steel Co., Ltd.	—	—	—	—	2	½	8	—
Carnforth Hematite Iron Co., Ltd., Carnforth	—	—	—	—	—	—	3	1
Darwen & Mostyn Iron Co., Ltd., Darwen	—	—	—	—	—	—	2	—
Wigan Coal and Iron Co., Ltd.	—	—	—	—	—	—	7	—
North Lonsdale Iron and Steel Co., Ltd.	1	1	—	—	1½	1	4	2
Partington Steel & Iron Co., Ltd., Irlam, near Manchester	2	—	—	2	2	2	6	—
Totals	4	2	—	2	6½	4½	32	3

Derbyshire.

Stanton Ironworks Co., Alfreton	—	—	—	—	—	—	3	—
Butterley Co., Ltd., Alfreton (Butterley Wks.)	—	—	—	—	1	1	2	—
Clay Cross Co.	1	—	1	—	1	1	3	—
Denby Iron and Coal Co.	1	—	1	—	1½	1	4	1
E. P. Davis, Bennerley ..	—	—	—	—	1	½	2	—
Ditto, Erewash ..	—	—	—	—	—	—	2	—
Renishaw Iron Co., Ltd., Chesterfield	1	—	1	—	1	1	3	—
Shrewbridge Coal and Iron Co., Ltd.	1	—	1	—	1	—	3	1
Staveley Coal and Iron Co., Ltd., Staveley and Devonshire Works	3	—	3	—	3	1½	11	1
Stanton Ironworks, Co.	4	—	4	—	4	2½	9	—
Totals	11	—	11	—	13½	8½	42	3
T. & I. Bradley, Ltd. (Capponfield)	—	—	—	—	—	—	2	—
Bradley & Foster, Ltd., Darlaston	—	—	—	—	—	—	2	1
G. & R. Thomas, Hatherton	—	—	—	—	—	—	2	—
Earl of Dudley, Brierley Hill	—	—	—	—	—	—	4	—
N. Hingley & Sons, Ltd., Dudley	—	—	—	—	—	—	2	1
Alfred Hickman, Ltd. ..	3	—	—	3	3	—	5	—
Willingsworth Iron Co., Ltd., Wednesbury	—	—	—	—	—	—	2	—
M. & W. Grazebrook, Ltd., Dudley	1	—	1	—	½	—	2	1
Cochrane & Co., Dudley	—	—	—	—	—	—	2	—
Baldwins, Ltd. (Netherton Furnaces)	—	—	—	—	—	—	3	1
Wm. Roberts (Tipton), Ltd.	—	—	—	—	—	—	2	—
The Birchill's Furnaces, Ltd., Walsall	—	—	—	—	—	—	2	—
Totals	4	—	1	3	3½	—	30	4

Gloucester, Somerset, and Wilts.

New Westbury Iron Co., Ltd.	—	—	—	—	—	—	2	—
Totals	—	—	—	—	—	—	2	—
GRAND TOTALS FOR UNITED KINGDOM .	81	22	41	15	88½	43½	485	66

New Furnaces Building (16).

DERBYSHIRE (2):—Stanton Ironworks Co., 1; Sheepbridge Coal & Iron Co., Ltd., 1.
SOUTH STAFFS (4):—Bradley & Foster, Ltd., 1: Willingsworth Iron Co., 2; T. & I. Bradley, 1.
LANCASHIRE (2):—Barrow Hematite Steel Co., Ltd., 1; Carnforth Hematite Iron Co., 1.
SOUTH WALES (2):—The Ebbw Vale Steel, Iron & Coal Co., Ltd., 1: Baldwins, Ltd., 1.
LINCOLNSHIRE (2):—Appleby Iron Co., 2.
DURHAM AND NORTHUMBERLAND (1):—Bell Bros., Ltd., 1.
NOTTS AND LEICESTERSHIRE (1):—Stanton Ironworks Co., Ltd., 1.
NORTH STAFFS (1):—Shelton Iron, Steel & Coal Co 1.
CUMBERLAND (1): United Steel Companies, Distington, 1.

Number of Furnaces in Blast on Dec. 31, 1921.

District.	Average in blast for Quarter.	Total in blast on Dec. 31, 1921.	Total in blast on Dec. 31, making Hem.	Spg. & Fdy.	Basic	Ferro-Man., etc.
Scotland	16	12	—	12	—	—
Durham and Northumberland ..	9½	9	3	2	2	2
Cleveland	11	13	9	4	—	—
Northamptonshire	3⅝	4	—	4	—	—
Lincolnshire	4	5	—	1	4	—
Derbyshire	13⅝	11	—	11	—	—
Notts and Leicestershire ..	2	2	—	2	—	—
S. Staffordshire & Worcestershire ..	3½	4	—	1	3	—
North Staffordshire	4	4	—	2	2	—
West Cumberland	3½	3	3	—	—	—
Lancashire	6½	4	—	2	—	—
South Wales	4½	6	—	1	—	—
South and West Yorkshire	5	3	—	2	1	—
Shropshire	—	—	—	—	—	—
North Wales	1	1	—	—	—	1
Gloucester, Somerset, and Wilts.	—	—	—	—	—	—
Totals	88½	81	22	41	15	3
Totals for Previous Quarter ..	43½	68	17	41	10	—

Average Number of Furnaces in Blast for the previous Six Quarters.

District.	Sept., 1921.	June, 1921.	March, 1921	Dec. 1920.	Sept. 1920.	June, 1920.
Scotland	8	—	52½	62½	71	74
Durham and Northumberland	4½	—	22	25	26½	24½
Cleveland	5½	—	40	45½	46½	43
Northamptonshire ..	—	—	6½	12	12½	13
Lincolnshire	1½	—	7	15½	19	18
Derbyshire	8½	—	22	31½	33	29
Notts and Leicestershire	2	—	5	4	5	5
S. Staffordshire and Worcestershire	—	—	9½	15	16	15
North Staffordshire ..	3½	1	7½	10½	12	12
West Cumberland ..	2	—	7½	13½	17	15½
Lancashire	4	—	10½	16½	18	17
South Wales	—	—	2	8	11½	11½
South and West Yorkshire	4	—	8½	10	10½	10
Shropshire	—	—	½	2	2	2
North Wales	—	—	1½	2½	1½	2
Gloucester, Somerset and Wilts	—	—	—	—	—	—
Totals	43½	1	202½	274	302	291½

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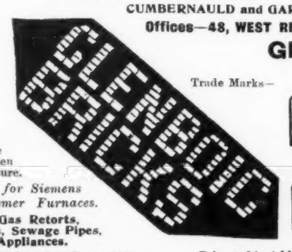

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and of cast iron. There was also, in cast iron, the question of the possible presence of oxygen, which was raised by Mr. Shaw at the Annual Conference of the Institution. This was a very puzzling question, which could by no means be answered offhand, but in discussing that question of the possible influence of oxygen on cast-iron it would be interesting to consider, among other things, the influence of the oxygen on fluidity. He hoped it might be possible to attract the attention of some more scientific men to the problems of the foundry. This had been a curiously neglected field of metallurgy. When it was considered all that had been done on the processes of the manufacture of steel, on the mechanical treatment of steel, heat treatment of steel, and so on, it was surprising how little had been done on the properties which were all important in the foundry. It was a matter on which accurate data was needed, and it would be well if the foundrymen, in their own organisations, could call the attention of the scientific world to the real need that there was for accurate information on this among other points affecting their industry.

BIRMINGHAM BRANCH.

ANNUAL DINNER.

The annual dinner of this branch, held on January 21, at the Imperial Hotel, Birmingham, was attended by representatives of many kindred societies, and was a great success. Mr. H. Field (Branch-President) was in the chair. An interesting programme of musical and humorous items had been arranged by Mr. Thomas Vickers, and was much enjoyed.

Foundrymen's Desire for Knowledge.

The toast of "The Institution of British Foundrymen" was proposed by MR. C. RETALLACK, Chairman of the Willenhall and District Ironfounders' Association. He said the great industry they represented was world-wide in its scope and permeated every avenue of commerce. Its importance was brought home to the public by the recent moulders' strike. It was satisfactory to find that the industry was so much alive and full of vim. Never in its history had those associated with it been so hungry for right methods, nor had the spirit of inquiry and research ever before been so keen. In spite of the competition of America, France, Belgium, and Germany, he believed we should recover anything we might have lost. He had no fear for the future of British ironfoundry when he saw what was going on around him every day. He expressed his appreciation of the deep and deepening interest taken by their managers, foremen and pattern-makers, without which they would be unable to carry on economically and successfully. He believed that never so much as to-day did their staff-men realise that we were up against forces in foreign countries which were difficult to overcome, and on that account he had no doubt as to the future of their industry. We were alert and progressive. Nothing undertaken in the industry in his time came near in importance and significance to the establishment of the Cast-Iron Research Association. He congratulated the Director, the Secretary, and all concerned upon the magnificent and detailed work which was being done. He had no doubt that before long things would be made easy which had been a source of difficulty all their lifetime.

Low Prices Necessary.

MR. OLIVER STUBBS, President of the Institution, of Manchester, in reply, said he felt that the ironfounding industry and kindred trades were on the eve of a revolution, inasmuch as we were beginning to realise that other countries besides Great Britain were able to manufacture goods as cheaply and probably as well as ourselves, and that if we were to continue to occupy our old position there would have to be less thought of afternoon tea and coffee and dominoes and a closer devotion to real, solid work. If men were willing to give their spare time to improving themselves, through the medium of the Institution, he thought employers should give to such men the preference for any post that might be vacant. He was a great believer in the principle that if they treated people well they would get a great deal out of them, and it appeared to him that there was something radically wrong with the country when so many hundreds of thousands of people were out of work. He urged that as managers, foremen and employers of labour they should make every endeavour to get down to rock bottom, and put goods on the market at a price calculated to stimulate trade, and so provide employment for those who were justly entitled to have it. He advised every branch to enlist the active help of the younger men. At a Council meeting that day a considerable number of new members had been passed, bringing an increase in subscriptions to the Institution of something like £130 per annum. He also mentioned that the membership now included twenty subscribing firms at five guineas each, which proved that employers recognised that good work was being done.

Foundry Products Improving.

MR. E. C. R. MARKS, President of the Midland Branch of the Institution of Mechanical Engineers, in submitting "The Birmingham Branch," said he could remember when the raw material supplied by foundrymen for the use of engineers was not all that could be desired. In the case of steel castings, which could now be absolutely relied upon, they were often, in the old days, when the skin had been taken off in the lathe, found to be full of holes. Owing to research and to the skill and attention given to the products of the foundry nowadays, the raw material supplied gave little cause for complaint. Further than that, as new conditions had to be met foundrymen seemed able to meet them. There was no longer suspicion of science in the foundries, but on the contrary, by the application of science to the practical affairs of the foundry they were able to meet the requirements of engineers.

Work of the Birmingham Branch.

MR. H. FIELD, President of the Birmingham Branch, responded. He commended to the members of the local branch present that night the fact that they had with them some fifteen or twenty gentlemen who had travelled long distances to be at the Council meeting that day, so that Birmingham members might realise that they were connected with a real live Institution with branches all over the country. The Birmingham Branch was one of the oldest branches, but it could not rest upon its oars. Laurels it had perhaps won in the past, but if they were to maintain their position as anything approaching the premier branch of the Institution it would entail hard work. The Institution catered not only for the manager but for the operative, and the Birmingham Branch desired to have representation from every foundry—one at least from the managerial side and at least one from among the operatives. If they were successful in that aim there would be sympathy between the two branches of the industry, without which neither could make any progress. He regretted that only about 25 per cent. of the members of the Birmingham Branch attended the meetings, and made a strong appeal for more support. They were not a highly scientific or technical organisation, at least they were trying not to be. They simply met to give practical help to one another.

Foundry Work a Key Industry.

In proposing "The Kindred Associations," PROFESSOR T. TURNER said the casting of metals was a very ancient and honourable art. It was the basis of modern civilisation, because apart from the casting of metals obviously we should have no metals to use, and if we had no metals to use we should go back to the stone age, and civilisation, as we knew it, would not be. As to when man first began to cast metals we did not know, but we knew that it was pre-historic. We knew that men cast coins. All the old coins were cast and not pressed, as they were to-day. So far as historic knowledge went in reference to the foundry art one of the earliest references he remembered was in Holy Writ, and had reference to the casting of the sockets of the Tabernacle in the wilderness. They were obviously familiar with the casting of metals in those days. Solomon cast some very large columns and some very big vessels, weighing tons, which would be considered quite respectable castings to-day. But it was not always in connection with true religion that our ancestors worked, for they also cast the golden calf in the wilderness and

the statue of Diana of the Ephesians. Further, he believed that there had been quite a trade in the manufacture of idols in Birmingham for others to worship in comparatively recent years. Arising out of the casting of metals came a subdivision of labour as a result of which men began to work those metals in various ways. There was, for example, the steel-maker of to-day. After all, he only finished what was done in the foundry. The same remark also applied to the brass trade, for what, after all, was the tube trade, the sheet brass trade or the wire trade but a further development of the casting of metals? Naturally, with the extension of mechanical knowledge, and with the greater requirements of industry, we had had specialised knowledge, and the result was the formation of special societies. To the representatives present that night of kindred societies they offered a warm welcome. There was no question of jealousy or interference as between the different societies. Personally he had many reasons to be grateful to these local societies for the assistance they had given him in his work and for the assistance they had rendered to his students.

The Value of the Institution.

Mr. H. B. Weeks, of Barrow (Chairman of the Council of the British Cast-Iron Research Association), in acknowledging the toast, said Birmingham was the home and birthplace of the British Non-Ferrous Research Association and the British Cast-Iron Research Association, and thus possessed a record second to none, of any provincial city in the country. The country owes a debt of gratitude to Birmingham for the pioneer work she has done in promulgating such Associations, and for the support she has always been foremost in giving to scientific and technical societies, having for their objects the dissemination of knowledge and for the application of scientific methods to the various industries with which the city is associated.

The objects of the I.B.F. are both educational and social, with a view to elevating the foundrymen's craft generally; he knew of no worthier object.

The subjects discussed relating to practical foundry problems, including the designs, patterns, moulding, melting and casting, could not fail to be of interest and of educational value to everyone taking part.

The ideal foundryman, or one that possessed expert knowledge on each of the above lines, was certainly an exception if not an impossibility at present. This would be a standing argument of the absolute necessity for the closest co-operation amongst those who were expert in each particular branch. How different would some designs for castings be if the designers had had any practical experience in the casting of metals and a knowledge of their behaviour whilst cooling!

He sometimes thought that greater benefits would accrue if some of the trade organisations would devote a portion of their energies towards the technical education of their members as being the best means of making industrial progress.

In such a case the local branches would provide facilities for the worker with hand or brain to meet and consider and discuss technical problems arising in their everyday work, and they would soon realise the significance of each other's standpoint. Such meetings would become consultative, and practice and theory would soon need to agree, as it would be demonstrated that where they did not agree there was something wrong either with the theory or the practice, and probably some research work would be required to elucidate the truth.

The Activities of the B.C.I.R.A.

He then spoke of the activities of the British Cast-Iron Research Association. In the earlier stages of the late war, it was abundantly demonstrated that many of our industries were technically in a very bad way, and that we were a long way behind our enemies in many of the essentials of success. Hurried consultations were held, and researches organised in a number of branches, but how far we were dependent upon enemy resources is evidenced by the fact that we started the war with German fuses for our shells, with German sights for our guns, German magnetos and plugs for our motor transport and aircraft, German sulphuric acid and toluol for our high explosives, with German optical glass for our binoculars, German electric bulbs for our ships, German high-speed steel for our machine tools, and with German spelter for our brass and gun-metal alloys! Thanks to the co-operation of British scientists, chemists, metallurgists, and engineers with the manufacturers and craftsmen, we were able during the war to make ourselves independent of and superior to Germany in the manufacture and production of every one of the above-mentioned essential materials. With the spirit of "never again" would we be caught "napping," and with a full sense of the absolute need for a proper organisation of our resources the Government introduced Research Associations to promote co-operation amongst those engaged in various industries with a view to bringing scientific knowledge into the most intimate relationship with British industries in order to enable manufacturers of this country to hold their own with the increasingly keen international competition of modern times.

The success of the Government scheme has been illustrated by the fact that 26 industries have applied for and formed Research Associations, including the Cast-Iron Research Association, which the Institution played so prominent a part in inaugurating and has taken so active an interest in since its incorporation. He could not speak too highly of the part the Institution played towards ensuring the success of the Association, and he was quite sure that such friendly and cordial relationships as exist between the two Associations cannot but conduce largely to the success of both. Notwithstanding the advantages that must accrue from membership, there is an apparent apathy that does not speak well for the prescience of firms engaged in the industry. There are about 3,000 foundries in Britain, and up to date we have only about 1/20th of this number of applications for membership. It is significant that the largest firms, who in many cases have their own well-equipped laboratories and research departments, are the most eager to join. This is because they more fully appreciate the possibilities and benefits likely to accrue. In any case it ought to be an inducement to others to join, as the greater the membership, the larger the income and the larger the amount will be available for carrying out the research problems which are put before us. Naturally, only members are entitled to propose subjects for research, and only members are entitled to receive the results, which they are under obligations to treat as private and confidential. The C.I.R.A. had already achieved an amount of success which was very gratifying in view of the short time it had been incorporated, and it had had ample proof of the need for such an Association which those who have benefited by the work already undertaken have agreed has already justified its existence. You may rest assured that the money contributed will be spent on what it is intended for—the essentials of research—and not be absorbed in the preparation of record cards, statistics or administration.

New British Chemical Standards. — There is now ready for issue a new steel, carbon steel "A 2," which is of special value, both as a dead-mild analytical standard very low in impurities, and also as a "pure" iron sample for standardising bichromate and other volumetric solutions. The analyses have been undertaken, as usual, by a number of experienced chemists both in the United Kingdom and the United States, representing the following interests: British Government Department: U S Bureau of Standards; referee analysts, independent; railway analysts, representing users issuing specifications; and works analysts, representing makers and users. The standard figures of carbon steel "A 2." are:—Carbon (combined), 0.039; silicon, 0.036; sulphur, 0.020; phosphorus, 0.008; manganese, 0.043; arsenic, 0.031; nickel, 0.06; chromium, 0.013; copper, 0.065; oxygen, 0.04; iron (by difference), 99.64 per cent. The standard turnings may be obtained in 500, 100, or 50-gramme bottles, either direct from Organising Headquarters (3, Wilson Street, Middlesbrough) or through any of the leading laboratory furnishers at a price just sufficient to cover cost. A certificate giving the names of the analysts co-operating, the types of methods used, and a detailed list of the results will be supplied with each bottle.

Correspondence.

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Keighley Laboratories, Limited.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The description of the Research Laboratories at Keighley and of Mr. Poole's other work as indicated in the research on white patches in grey-iron castings cannot fail to be of interest to all progressive foundrymen.

The fact that foundry concerns are becoming alive to the value of research is in itself encouraging, and the foundries in the neighbourhood of Keighley are fortunate in possessing a well-equipped laboratory where both routine and research work can be undertaken.

As interested in the larger project now being furthered by the British Cast-Iron Research Association in conjunction with the Department of Scientific and Industrial Research, I think it should be stated that laboratories of the Keighley type are being, and will be, used freely by the B.C.I.R.A. in carrying out researches and investigations in connection with the numerous problems now being submitted daily for solution and advice.

The wide scope and area covered by the B.C.I.R.A. is naturally bringing to the central clearing house a mass of problems for investigation, which, on being grouped, become much more interesting and valuable. For, as one difficulty so often throws light upon another, the work of the Research Committee and the Director is made practically and generally useful.

Mr. Poole has clearly realised this in his work on the problem alluded to in your issue, and the writer would seek to emphasise the similar but greater possibilities in the way of the B.C.I.R.A.'s work.

It may interest your readers to learn that over a hundred problems, many of them involving fundamental investigations of the nature of the case described, have already been submitted for solution. In not a few cases long-standing troubles have been remedied and heavy financial losses obviated. Serious researches have been commenced on subjects suggested by problems introduced by members, one notable case, for example, being the research commenced on the causes and remedies for shrinkage and porosity defects in castings.

From every direction examples of defective castings due to these troubles have poured in, and, as so many factors are involved, the causes have had to be sought for in many directions.

The rationale of physical and chemical analysis of the metal; of efficient mixing, melting, pouring and cooling; of gating and riser positions; of pattern-making for correct moulding; of correct mould-making and of sand composition and preparation, and, importantly, the matter of casting design, are involved.

All these are, severally, or separately, responsible for such shrinkage and porosity defects as have been illustrated in the samples submitted to the B.C.I.R.A. for investigation.

In a word, the thoughts of the designing engineer, metallurgist and foundryman have to be brought to bear on the bulk of present-day foundry difficulties, and it is only by a wholesale collection of varied examples that sufficient light can be thrown on this complex subject.

The problem attacked by Mr. Poole has already had the attention of the B.C.I.R.A. and help given on their special and immediate hard-spot difficulties. Further help will be forthcoming when the particulars of the fuller research now in hand, dealing with the family troubles incidental to phosphoric irons, are completed. It may be remarked in passing that the good effect of 0.5 per cent. and upwards of manganese in softening such irons as Mr. Poole's research covers, has long been known, and the troubles due to high sulphur in the first run metal and in later small "tappings" have been corrected by ferro-manganese additions.

It is not, however, in high sulphur irons alone that the white hard spot troubles occur, and one has to look much further in other directions than those touched upon by Mr. Poole for causes and remedies. It is clearly a national necessity, becoming more obvious daily, that the needs of the hundreds of small foundries in the matter of research and advice on the many perplexing difficulties associated with analysis, grading and mixtures of iron, and the question of design, moulding and casting, should be met. Such laboratories as that of Keighley should be kept continuously occupied by the problems which should flow through the central clearing house of B.C.I.R.A., were that association supported as it should be by every British iron-founding concern. The first bulletin of work undertaken by the B.C.I.R.A. which will deal with the answers to certain specific groups of problems already submitted and advised upon will, very shortly, put the present members in possession of a good deal of the ground work which, in many cases, is preparatory to fundamental research of extensive character, such as cupola slags and linings, moulding sands, anti-corrosive cast irons, motor-car cylinders, and shrinkage and draw phenomena. It must be remembered that the work of the B.C.I.R.A. has only as yet had a six months' run, and entirely new grounds have had to be opened, but already, owing to the generosity of foundry enthusiasts, the Bureau of information has now the nucleus of an excellent library of foundry literature, supplemented by an indexed record of some thousands of articles on foundry topics, together with regularly supplied British, Colonial, American and Continental technical journals. The interest and assistance of well-known foundry experts on the Research Committee has materially benefited the Director in his work, and there is ample justification for the statement that the researches on fundamentally important foundry problems will bear useful fruit at no very distant date, though the work which is being undertaken, being complex and difficult, will take some time to complete.—Yours, etc., J. E. FLETCHER,

Director of Research (*pro tem.*) B.C.I.R.A.

Publications Received.

"THE BRITISH TRADE REVIEW, JANUARY, 1922." 115-17, Cannon Street, London, E.C.4.

"THE INDUSTRIAL LEAGUE AND COUNCIL JOURNAL, JANUARY, 1922," price 3d. 82, Victoria Street, London, S.W.1.

"PROCEEDINGS OF THE SOUTH WALES INSTITUTE OF ENGINEERS," January, 1922. Published by the Institute, Park Place, Cardiff.

"ANNUAL BULLION LETTER, 1921." Messrs. Samuel Montague & Company, 60, Old Broad Street, London, E.C.2.

"FORCED DRAUGHT FURNACES." Messrs. Meldrums, Limited, Timperley, Manchester.

"BLOWING AND EXHAUSTING MACHINERY AND FOUNDRY PLANT." Messrs. Thwaites Bros., Limited, Vulcan Iron Works, Bradford. The former embraces both high and low pressure positive machines, and the latter with cupolas, blowers, hoists, cranes, charging machines, core ovens and carriages, pig breakers, core wire straightening machines, portable sand elevators, ladles, Stock and side blown converters and electric furnaces, rotary sand dryers. Altogether this makes a very handsome and useful catalogue for foundrymen.

Wages and Hours in America.—The Managing Director of the National Industrial Conference Board at the recent annual convention of the American National Founders' Association, exhibited some charts showing that in July, 1914, the average wages properly weighted of all classes of workers (skilled, unskilled, and women) in the foundries was 27.4 cents (say 13¾d.) per hour. This had reached 63 cents (say 2s. 8½d.) per hour in July, 1920, and was 56.1 cents (2s. 4d.) in July, 1921. The charts showed radical changes from July, 1920, which represented the peak of activity, to July, 1921, by which time the slump was in the valley. In this period there was a 13½ per cent. decline in hourly wages; 26.8 per cent. decline in weekly earnings, and 44.5 per cent. decline in employment. The average weekly wage was $13.52 (say £2 16s. 4d. at par) in July, 1914, about $33 (£6 17s. 6d.) in July, 1920, and $23.62 (£4 18s. 5d.) in July, 1921. In July, 1920, the number employed was 438,000, and in July, 1921, 243,000. The number of hours worked per week was 53.5 in 1914, and 52½ in the war period, and nominally has remained at this figure since though actually different. In July, 1920, there was an average of 50 hours per week of plant operation, but in July of this year 41.5 hours per week.

Trade Talk.

THE BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION has removed to 15, Savoy Street, Strand, W.C.2.

MESSRS. J. CUNNINGHAME & COMPANY have established an ironfoundry in Court Street, Haddington.

MESSRS. MORLEYS, iron merchants, have removed to 7, Temple Chambers, Broad Street Corner, Birmingham.

MESSRS. J. LYON & COMPANY, iron and steel merchants, have removed to 90-96, Cranmer Street, Liverpool.

ARMYTAGE & JONES, LIMITED, iron and steel merchants, Sheaf Street, Sheffield, will in future be known as Armytage & Sons, Limited

MESSRS. WILLIAM JACKS & COMPANY, 5, East India Avenue, London, E.C.3, have removed to Winchester House, Old Broad Street, London, E.C.2.

FRY'S (LONDON), LIMITED, engineers' tool manufacturers, 46, Upper Thames Street, London, E.C., have appointed Mr. W. I. Dougall as their Scottish representative.

MR. J. FEARN gave an interesting lecture, entitled "Drop Forgings," to the members of the Junior Institute of Engineers in the Cutlers' Hall, Sheffield, on January 27.

THE REDBOURN HILL IRON AND COAL COMPANY, LIMITED, have removed from Kern House, Kingsway, W.C., to Caxton House, East Block, Tothill Street, Westminster, S.W.1.

THE SAMBRE AND MOSELLE WORKS OF BELGIUM have, it is reported, secured a contract for from 40,000 to 50,000 tons of steel rails and accessories for the Argentine State Railways.

THE OUTPUT FROM the Wear shipyards for the month of January totalled three vessels aggregating 12,527 gross tons, compared with two vessels and 5,750 gross tons for January, 1921.

THE Port Talbot Steelworks and the Margam Iron Works, owned by Baldwins, Limited, have again closed down, with the exception of the old portion of the Port Talbot works.

BANISTER, WALTON & COMPANY, LIMITED, announce that in future the whole of their business will be transacted at offices adjacent to the works, in Ashburton Road, Trafford Park, Manchester.

THE NEW steel and iron works of the Nethans Rods and Bars, situated near North Motherwell, started operations recently. The start so far is on a small scale, but the works will gradually absorb quite a large number of men.

MR. R. LOWNDES, secretary of the Midland Iron and Steel Wages Board, announces that the wages regulated by the sliding scale under the Midland Iron and Steel Wages Board will be reduced 20 per cent. from Monday, February 6, to Saturday, April 1.

THE DURHAM COUNTY WATER BOARD are asking for tenders for the supply of 5,500 tons of cast-iron pipes. Particulars may be obtained from Messrs. T. & C. Hawkesley, 62, Broadway, Westminster, London, S.W.1, on payment of a deposit of £3 3s.

MESSRS. VIESSING & COMPANY, of The Hague (Holland), announce that they have been appointed by the Société d'Exportation de Manganèse de Tchiatourie (Georgie) sole agents in all countries for the sale of manganese ores, etc., exported from the Caucasus.

IT IS ANNOUNCED that the contract for the supply of pumping machinery for London's new reservoir at Littleton—between Staines and Shepperton—has been secured by Worthington Simpson, Limited, Kingsway, W.C. It is understood that the contract price is £56,865.

MESSRS. J. C. BISHOP AND O. COYLE, joint secretaries of the Scottish Manufactured Iron Trade Conciliation and Arbitration Board, have been informed by Mr. J. M. MacLeod, Glasgow, that the average net selling price for November and December brought out was £14 5s. 1.14d. per ton. This means a decrease in the wages of the workmen of 12½ per cent. on basis rates.

ASKED IN THE HOUSE OF REPRESENTATIVES, Wellington, N.Z., if a contract had been given for hydro-electrical supplies to a British firm, notwithstanding a tender from a New Zealand company handling American machinery for £14,000 less, Mr. Massey, the Prime Minister, replied that the difference was £13,000, which would be reduced by the preference tariff to £7,000.

ONE OF Hollings & Guest's horizontal four-throw chain-driven hydraulic pumps has been selected by the Baroda State Railways for the purpose of working hydraulic presses in their Baroda workshops. The firm is also supplying a large hydraulic accumulator to work in conjunction with this plant. The East Indian Railways have also recently ordered a hydraulic briquetting press from this firm.

THE VISCO ENGINEERING COMPANY, LIMITED, 82, Victoria Street, London, S.W.1, have appointed Mr. F. J. Rynd, of Motor House Chambers, Wood Street, Cardiff, as their sole representative for the South Wales district; Mr. Charles J. Sellar, of 144, St. Vincent Street, Glasgow, for Scotland; and Mr. P. S. Thompson, of Grafton Chambers, 99, Albert Road, Middlesbrough, for the North-East Coast.

SCOTTS' SHIPBUILDING AND ENGINEERING COMPANY, LIMITED, Greenock, have received an order from Messrs. Alfred Holt & Company, Liverpool, for a twin-screw vessel, 400 ft. in length, 52 ft. in breadth, and 32 ft. in depth. An interesting feature in connection with the contract is that the vessel is to be propelled by Scott-Still engines, having a combined brake horse-power of 2,500 under service conditions.

THE MEMBERS of the Welsh Engineers, Founders and Allied Trades met at Swansea to receive reports of the joint meeting recently held at Swansea with regard to the employers' claim for a reduction of wages. The delegates explained that the employers had proposed a wage reduction of 5s. from February 1, and a further 5s. from April 1. The proposals as submitted were accepted by the workers.

GIBBONS BROS., LIMITED, announce they have entered into arrangements with the W. S. Rockwell Company, of New York, U.S.A., as their representatives for the British Empire, excluding Canada, for the manufacture of their industrial heating furnaces. British engineers who have been through American factories will no doubt recall the Rockwell furnaces at work, and will be interested to know they may have similar furnaces built and erected in England without the necessity of having materials shipped from America.

THE DISPOSAL AND LIQUIDATION COMMISSION recently sold to the Pickett Metal Corporation a large stock of surplus empty ammunition lying in this country. The taking apart of the various metals used in the manufacture of these shells, bombs, hand grenades and other empty ammunition purchased has provided regular work for some time past for over 2,000 persons in different parts of England and Scotland. The total tonnage available at the present time amounts to about 140,000 tons, but about half of this quantity has already been completed, between 11,000 and 12,000 tons being broken down weekly.

THE untimely death of Sir Ernest Shackleton recalls the fact that on the Island of South Georgia, which is some 2,000 miles from civilisation, a small iron foundry is to be erected. Quite recently the Constructional Engineering Company, Limited, of the Titan Works, Charles Henry Street, Birmingham, despatched one of their small complete plants with necessary equipment and requisites to the whaling station at Grytviken. This plant is intended for making castings for repairs to the machinery at this station, and also any necessary repairs to the ships which call at this island three or four times a year.

THE ANNUAL DINNER of the Newcastle and District Branch of the Institution of British Foundrymen took place at Newcastle, on January 28. The chair was occupied by the president, Mr. R. O. Patterson, of Messrs. Smith, Patterson & Company, of Blaydon, who had the support of the two vice-presidents, Mr. H. J. Young, of the North-Eastern Marine Engineering Company, and Mr. S. W. Wise. Among the guests were the Deputy Lord Mayor (Captain Arthur W. Lambert), Sir Archibald C. Ross, of Messrs. Hawthorn, Leslie & Company, Limited, Mr. Oliver Stubbs, of Birmingham, the President of the Institution; and Professor H. Louis, of Armstrong College, Newcastle. Mr. H. A. J. Rang, of St. Nicholas' Buildings, Newcastle, carried out the secretarial duties.

THE 78TH ANNUAL REPORT of the Royal Metal Trades' Pension Society, which was presented to the meeting of subscribers, held on Wednesday, January 25, Mr. John S. Balfour, J.P., in the chair, states that an attempt is about to be made to extend the number of district committees, Liverpool, Manchester, Newcastle, Middlesbrough, etc., being marked out as likely centres for branches. At the next Festival, Mr. William Clark, managing director of Vickers, Limited, Sheffield, will preside. The vice-chair will be occupied by Mr. John Hall (Messrs. Hall & Pickles), Manchester. During the year 261 persons were relieved to the extent of £6,167. The deaths numbered 21. On December 31 last 220 permanent annuitants were on the books. Mr. James Whitby (John Summers & Sons, Limited) and Mr. Ronald Wyman (Guest, Keen & Nettlefolds, Limited) have joined the Board of Management. Since the last issue the Society has lost two members of the Board, viz., Mr. John R. Hickman and Mr. James Coote Garnham. Messrs. A. Gardiner, J. W. Palmer, M. Hobbs, R. D. Howard, and H. L. Wethered have joined the Bristol Committee.

Catalogues Received.

MESSRS. SAMUEL OSBORNE & COMPANY, LIMITED, Clyde Steel Works, Sheffield. (1) "Manganese Steel Castings and Forgings." (2) "Toughened Steel Castings and Forgings." The first of these catalogues contains some useful notes on the heat treatment of manganese steel.

IRON AND STEEL MARKETS.

Pig-iron.

Conditions in the pig-iron trade continue far from satisfactory, the increased demand anticipated when prices were recently reduced, having completely disappointed expectations, and, if anything, at present seems confined to the satisfaction only of the more pressing requirements of consumers. Prices are now admittedly at the lowest possible levels consistent with a bare margin of profit for producers, but buyers still hold off, and market reports in most instances suggest continued apathy in movements. In South Staffordshire most of the furnace plants remain idle, the small tonnage of pig-iron in use being drawn from other Midland centres. In the Black Country, especially, many manufacturing concerns are still short of orders, with the result that works are not consuming the usual quantities of pig, foundries now suffering more in this respect than has been the case for years. In the Cleveland market the brisk movement noted last month has been followed by a period of inactivity, foreign inquiries having fallen off considerably, and with the home demand continuing quiet business has again become restricted in volume. Only a limited trade is being done in the Scottish markets, the demand being very small, but no further cut in prices need be anticipated at present; indeed, it appears to be the fact that the Cleveland makers have actually had under consideration the question of raising prices. Evidently the decision was against such action, but at the same time the fact that such a proposal was advanced indicates that at last the limit of concession has been reached, and that at least a temporary measure of stability has been reached at the following levels:—No. 1 Cleveland and silicious iron, 95s., No. 3 Cleveland G.M.B., 90s., No. 4 foundry 87s. 6d., No. 4 forge 82s. 6d., mottled and white (nominal) 80s. per ton f.o.t. or f.o.b.

There is a fairly good demand for East Coast hematite, but the output is fully equal to present requirements. Good sales have been made abroad, and some makers are not inclined to cut below 95s. per ton for mixed numbers, and 97s. 6d. for No. 1, though it is still stated to be possible to shade these prices. There appeared to be some intelligent anticipation in the quotations for West Coast hematite supplied from Sheffield last week, which offered Bessemer mixed numbers at £5 15s. local delivery, a reduction of 10s. on the then official basis. The ironmasters have now reduced their official basis to this figure, with the intimation that there will be no further reduction for some considerable time, as iron is now being manufactured at a loss.

Finished Iron.

The outlook in the finished iron section of the trade is without appreciable change for the better, demand being still confined within very restricted limits mainly for home requirements, with, at present, little indication of an early expansion of export movements. Competition for any orders offering in the market is consequently keen, and by no means altogether due to Continental producers, home manufacturers in some districts under-quoting prices in order to secure business, while steel material can in many instances be bought at figures considerably less than current values for iron. Makers of South Staffordshire bars are in consequence doing little fresh business, very few of the mills in this district having sufficient work in hand for more than part-time employment. The marked bar houses are, however, moderately supplied with specifications, while the commoner qualities are difficult to dispose of at the recognised Association quotation of £13 per ton, some makers outside the official group offering as low as £12, and even less, as reported. The Scottish makers of malleable bar iron decided, at a meeting last week, to reduce prices in the home trade to the extent of 20s. per ton. This brings "crown" quality to £11 10s. per ton for delivery at Glasgow stations, the reduction to take effect from Monday, February 6. The list of extras has also been revised. The exports of manufactured iron and steel from Tees-side were well maintained during January, the total being 43,622 tons, as compared with 47,681 tons in December, a decrease of 4,059.

Steel.

Business in all lines of the steel trade shows some signs of revival, except, perhaps, in the branches producing the heavier descriptions of material, such as railway requirements, the armament section having been definitely suspended in accordance with the Washington decision. There are, however, some orders coming to Sheffield from Russia, which are providing work for several of the local tool-making firms, but further developments in that direction are hindered by the uncertainty of the financial position. The most promising sign of a revival in the local steel trade is perhaps to be found in the report that the contract for 70 electric locomotives for the South African railways secured by the Metropolitan Vickers Company will help Sheffield's industrial recovery, as will the contracts for 15,000 tons of steel rails obtained by Cammell Laird and the United Steel Companies from the Midland Railway Company. Further railway business is expected before long, for the replacement of rolling stock, rails and materials is becoming imperative. South America are also showing a tendency to come into the market again for steel.

Scrap.

Probably the most noteworthy feature in the Midlands scrap market recently is the fall in the prices offered for cast-iron scrap. Up to a week or so ago £4 5s. to £4 10s. was being realised without difficulty. At the present moment it is difficult to realise more than £3 15s. up to £4 for the very best qualities. Quotations for other qualities rule about as follow:—Heavy steel scrap, £2 10s. to £2 15s.; stamping scrap, £2 5s.; heavy wrought-iron piling scrap, £3 15s.; balling iron, £3 5s.; steel turnings, £1 15s.; cast-iron borings, £1 7s. 6d.; light cast-iron scrap, £3; in each case f.o.r. the Midlands.

Tinplates.

The demand for tinplates of late has been anything but active, and sellers are finding difficulty in negotiating business, very few fresh orders coming forward to replace the contracts already completed. Failing an early improvement in demand, makers are contemplating some reduction in output. Prices, consequently, show a lower tendency, 19s. having been accepted last week for coke tinplates in I C 14 by 20, 112 sheets 108 lbs., and 38s. 3d. for I C 28 by 20 in double boxes, but there were not many sellers at these figures. Oilsizes are extremely quiet, and prices are quite nominal, while wasters meet with an indifferent demand.

Metals.

Copper.—For some time past prices in the standard copper market have shown a downward tendency, and this week's report has been no exception in that respect, although no very violent fluctuations are recorded. Manufacturing demand, however, continues poor, owing partly to severe foreign competition, consumers, as a rule, holding only limited stocks. At this week's opening market business developed a more active tendency, February dates being done at £61 5s. to £60, March £61 5s. to £61 10s., and April £61 15s. to £61 12s. 6d. Refined sorts were easier, with electrolytic 20s. lower at £68 to £70, and wire bars showing a similar decline at £69 to £70. Closing prices:—Cash: Wednesday, £63 5s.; Thursday, £62 7s. 6d.; Friday, £61 12s. 6d.; Monday, £61 10s. Tuesday, £61 7s. 6d. Three months: Wednesday, £64 2s. 6d.; Thursday, £63 7s. 6d.; Friday, £62 10s.; Monday, £62 10s.; Tuesday, £62 7s. 6d.

Tin.—Recent advices from the East reporting sales of Straits tin at £157 10s. c.i.f., had a steadying influence at the opening market on this side, three months being done at £156 10s. No improvement could be traced in general consumptive demand, quiet conditions in the home tinplate trade restricting demand in that quarter, while operators' transactions were chiefly confined to the three months' position. Offerings, however, were fairly well taken up, the opening market closing steady with a good turnover of metal, with both positions slightly improved on balance. English ingots also closed with an advance of 10s. at £154. London tin stocks have increased 265 tons on the week to 4,977 tons; Liverpool stocks have decreased 53 tons to 1,939 tons, with Swansea unchanged at 10 tons. Closing prices:—Cash: Wednesday, £158 10s.; Thursday, £156; Friday, £154; Monday, £154 5s.; Tuesday, £155 15s. Three months: Wednesday, £160 5s.; Thursday, £157 17s. 6d.; Friday, £155 17s. 6d.; Monday, £156 5s.; Tuesday, £157 15s.

Spelter.—Movements in the week's spelter markets have presented few outstanding features, offerings of metal having been on a heavier scale, but were met with fairly good buying, February dates being done at £24, March £24 5s., and May £24 15s., with a substantial turnover recorded. Closing prices:—Ordinary brands: Wednesday, £25; Thursday, £24 15s.; Friday, £24 10s.; Monday, £24 10s.; Tuesday, £24 5s.

Lead.—There has only been a limited demand in the market for soft foreign pig, for which near dates have declined 7s. 6d., and forward metal 10s. February was done at £21, March £21, and April £20 17s. 6d., while in sympathy English lead registered a loss of 15s. English closing prices: Wednesday, £23 10s.; Thursday, £23; Friday, £23; Monday, £22 5s.; Tuesday, £22 10s.

XUM

Company News.

Phœnix Bolt and Nut Company, Limited.—Capital £10,000.

Dalmellington Iron Company, Limited. — Interim ordinary dividend, 6d per share, free of tax.

Consett Iron Company, Limited.—Interim ordinary dividend passed; preference dividend paid.

Birmingham Railway Carriage & Wagon Company, Limited.—Further ordinary dividend 1s. per share, free of tax.

Walter Charles Croxton, Limited.—Capital £3,000 in £1 shares. Engineers. Directors: W. E. Hartwell and W. C. Croxon.

Matrix Case-Hardening Company, Limited.—Capital £500. Directors: F. Bagnall and C. I. Wroe. Manager: F. Bagnall, Castle Road, Kenilworth.

Robert H. Leyland & Company, Limited.—Capital £3,000 in £1 shares. Ironfounders. Secretary: R. H. Leyland. Registered office: 242, Lever Street, Bolton, Lancs.

Mond Nickel Company, Limited. — Ordinary dividend, 6d. per share, free of tax, for year; interim cumulative and non-cumulative preference dividend, 3½ per cent.

James Caddick (Brass Casters), Limited. — Capital £1,000 in £1 shares, to take over the business of Agnes Caddick, Cambridge Street, Bilston. Registered office: 23, Cambridge Street, Bilston.

Watt Electrical Company, Limited.—Capital £600.

Wensley Fold Foundry, Limited.—Capital £500 in £1 shares. Directors: J. T. Pearson and Mrs. A. Kelly. Registered office: Wensley Fold, Blackburn, Lancs.

Veco, Limited.—Capital £1,000 in £1 shares. Manufacturers of electrical accessories. Directors: C. L. Douthwaite and R. Lindley. Secretary: H. Simpson. Registered office: 6, Back York Place, King Street, Leeds.

Allen-Liversidge, Limited. — Net profit, £30,500; brought in, £1,000; dividend, 10 per cent.; written off expenses in connection with new issue, etc., £4,100; reserve against corporation profits tax, £1,800; carried forward, £3,200.

Spensers (Scotland), Limited.—Capital £9,000 in £1 shares (3,000 10 per cent. preference). Manufacturers of electric and gas plant, etc. Directors: A. H. F. Hodgson and J. Plucknett. Registered office: 119, George Street, Edinburgh.

Gazette.

THE CREDITORS of the Cosmos Engineering Company, Limited, should forward particulars of their claims by March 6 to Mr. T. Dudley Locke, joint liquidator, 44, Gresham Street, London, E.C.2.

AT THE LONDON BANKRUPTCY COURT, Mrs. M. C. Page, previously trading as Kenneth Page & Company, metal merchants, London and Birmingham, applied for her discharge. It was pointed out that debtor owed £12,000, against assets amounting to £66. The order of discharge was suspended for two years.

A MEETING of the creditors of the Nechells Metal Company, Limited, 60, Mount Street, Nechells, was recently held at the office of the Birmingham Official Receiver. A statement of affairs, as regards creditors, showed an estimated deficiency of assets to meet liabilities, subject to the cost of liquidation, of £6,469, to which was added £202 for ordinary shares of £1 per share held by four shareholders, bringing the total deficiency to £6,671. The Official Receiver said that in February, 1921, the company purchased leasehold property consisting of three houses and foundry in Gem Street, Birmingham, together with the plant, stock and tools of a brassfounder's business, carried on there by Mrs. H. Geen. The purchase price was agreed between Mr. Andrews and the vendor at £2,000, and was paid for by the issue of debentures in the company for that amount bearing interest at eight per cent. per annum. These were the only debentures issued by the company. Recently two judgments were obtained against the company, and in October, 1921, an execution was levied for £325, which resulted in a Receiver being appointed by the debenture holder, who took possession of all assets of the company, and at a meeting held on November 5, 1921, a resolution was passed that the company be wound up and a liquidator appointed. Mr. C. T. Appleby was appointed liquidator, and a committee of inspection was elected.

MR. A. GOODMAN has been appointed to succeed the late Mr. F. R. Stone as manager of the steel-metal department of Frederick Braby & Company, Limited.

MR. WM. REAH, assistant manager of Joseph Pugsley & Sons, Limited, Cattybrook Iron Works, Bristol, is resigning, and joining M. B. Wild & Company, Limited, engineers, Nechells, Birmingham. He will take charge of their interests in the South-West of England, and will take up his residence in Cardiff very shortly.

Foundry Queries.

22a.—I should esteem it a great favour if any of your readers could give me a mixture of iron that would withstand vitriol acid.—"I.B.F. Member, Lancashire."

22a.—In reply to the inquiry from the Lancashire Branch Member who requires a mixture to withstand vitriol acid, it should be stated that it partly depends upon what strength of sulphuric acid which has to be dealt with as to what kind of iron he should use for a mixture. When this acid attacks an iron pan it forms a sulphate salt which is soluble in water but not at all in pure sulphuric acid, so that with strong enough vitriol any close-grained metal would serve the purpose. The oldest fashion was to run a very low silicon iron thus casting a white iron pot, but only small sizes were possible with this on account of contraction difficulties and consequent high percentages of breakage during concentration of the acid. If it is only for storing the acid in an "egg" then a good brand of hematite iron would suffice, conforming to the analysis recommended by the American authority, J. J. Porter, who recommended the A.F.A. members to aim at 1 to 2 per cent. of silicon, 0.05 per cent. sulphur as a maximum, phosphorus less than 0.05 per cent., manganese between 1.0 and 1.5 per cent., the total carbon being about 3 per cent. Provided green sand were used in making the castings, then a close textured surface would result, and the difficulty of cracking by the formation of salts in the porous spaces or around graphite flakes, which has been known to burst many acid containers, would be obviated. Care would have to be taken in completely eliminating any chance of phosphoric scrap iron getting into the mixture, or pitting troubles would be immediate and dangerous. Some recently-patented ideas for acid-resisting metal in sulphuric acid manufacture incorporate the use of chromium irons, which have, however, to be carburised on the surface to make them sufficiently impervious to the higher concentrations of acid. The real dawn of acid-resisting metal came about with the use of high silicon irons in which the indirect effect of the silicon in softening common irons had been completely overwhelmed by the direct action of the silicon in hardening iron. The analysis of such metals show the presence of from 11 to 15 per cent. of silicon, sulphur and phosphorus fall within the usual hematite iron limits, total carbon is low, not more than 0.5 per cent. being advisable, and the manganese can either be about 0.3 per cent. or, if the pot walls are to be thick, then 2 to 2.5 per cent. is advisable. Several trade names have been applied to the different varieties of this high silicon metal, such as Tantiron in this country where it originated, but Duriron, Corrosiron and Ironac are all similar in composition and effect. If all the fittings and coolers as well as the cascade pans are made of this special iron then after a few weeks the output of acid will be for all practical purposes free from iron, not more than 0.0002 per cent. being detectable. The pans are very durable, and can withstand being heated to high temperatures, provided they are not too thick, and the amount of breakage is very small. The strength of this silicon iron is not quite as much as that of common iron, and it is not advisable to reckon on higher internal pressures in a closed vessel made of it than 40 or 50 lbs. per square inch, unless a protecting jacket is provided.—T. J. P.

Deaths.

MR E YOUNGS, of Messrs. E. Youngs & Company, engineers, Diss, Norfolk, has died at the age of 73.

MR. A. S. RAE, of Messrs. George Stephen & Son, iron merchants, Dundee, died recently at the age of 83 years.

MR. E. J. STANLEY, works manager and director of Aublet, Harry & Company, Limited, engineers, Peterborough, died recently.

COL. T. W. JONES, metal merchant, has died at his residence at Swansea. The deceased gentleman at an early age entered the office of the Cwmbwrla Sheet and Tinplate Works. His keen aptitude for business subsequently led to his appointment as manager of the works, and he had held this position for 25 years. In 1899 he retired to become secretary of the Welsh Sheet and Plate Association, and he remained so until 1908, when he set up in business as a metal merchant.